Popular Science

Founded MONTHLY 1872

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Look! East by South -- a Periscope!" See P. 194

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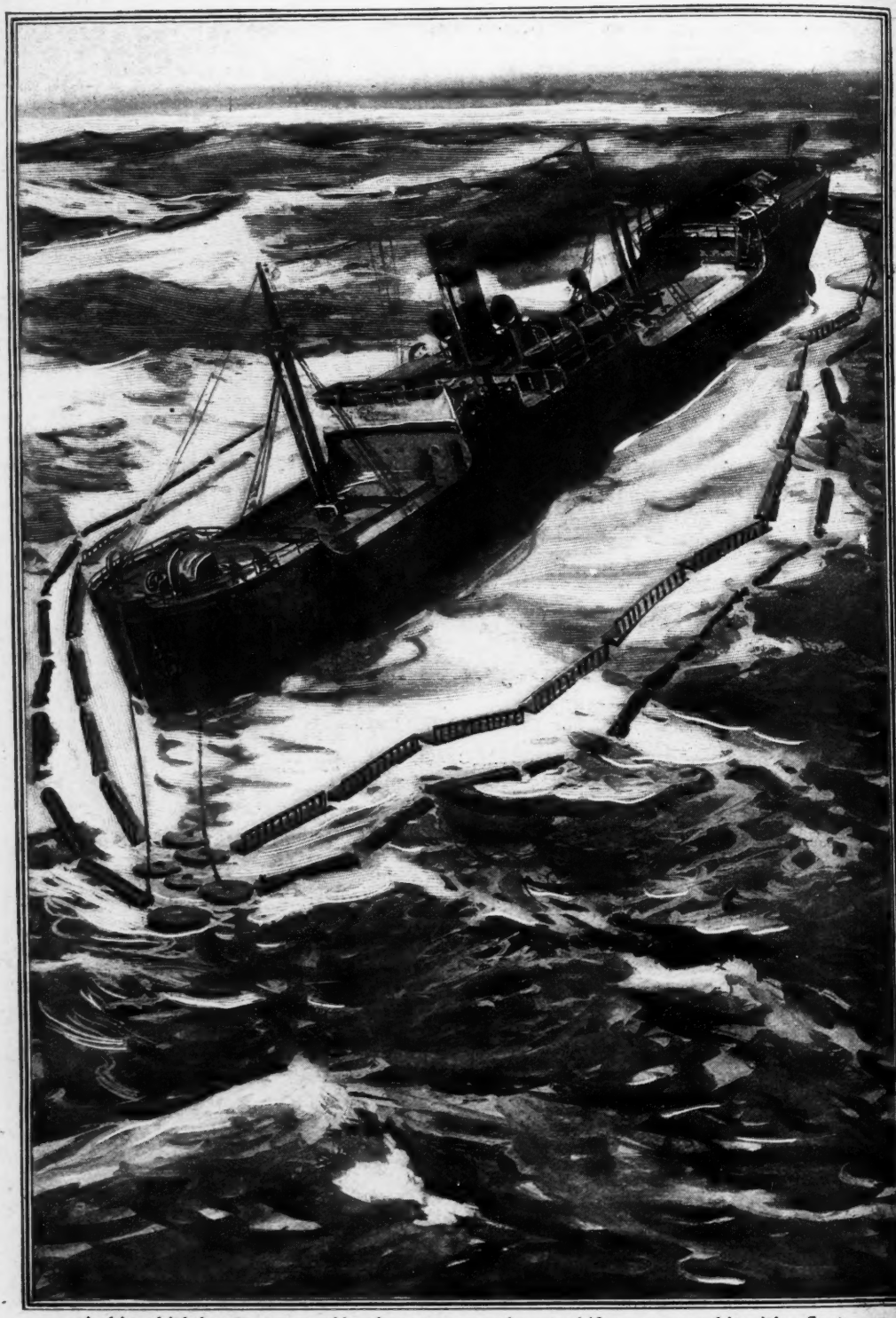
Saved by a Pool of Oil



A ship which has run aground in a heavy sea may be saved if you surround it with a floating breakwater and cover the water inside of the barrier with a film of lubricating oil

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Pour Oil on the Troubled Waters

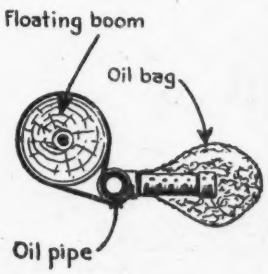
How to make a zone of smooth water around a stranded ship by means of a floating breakwater

A VESSEL, homeward bound and heavily loaded with a valuable cargo, misses the channel near the harbor entrance in the fog and runs aground. Perhaps she is merely stuck on a sand bar and can be towed free at the next high tide. More likely, however, she has struck a submerged rock, has sprung a leak and is gradually settling.

If the weather is calm and the sea not too rough there is a reasonable chance of saving vessel and cargo. But, will the weather remain calm long enough to make the salvaging of the ship possible? Even a moderate rise in the wind or a mere change in its direction may cause the waves to dash against the moribund craft and pound her to pieces.

Comparatively few stranded ships are ever saved from destruction. In many cases, where the conditions are unfavorable, even the crew is saved with difficulty. In such cases ship and cargo usually become a total loss.

The salvaging of stranded ships has been given considerable thought by inventors, but they directed their efforts principally upon methods of establishing communication with such ships and upon means for saving the lives of passengers and crew. Recently, however, an American, Jonathan Begg, of Oakland, Calif., has approached the subject from a different angle. In his invention, which was patented a short time ago, he seeks to prevent the destruction of the ship by surrounding her with a protective zone of smooth water.



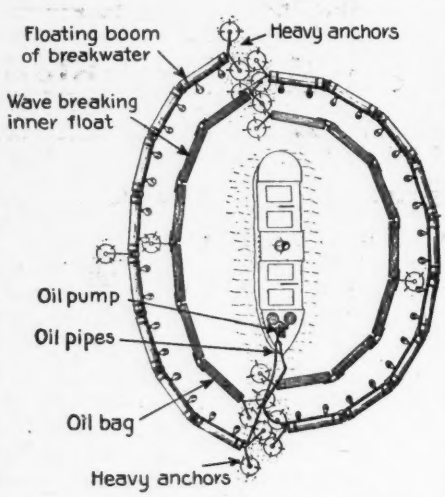
Pouring oil upon the troubled waters does the trick every time

The theory of Mr. Begg's invention is unimpeachable. The efficacy of breakwaters is based on well understood principles and so is the effect of pouring oil upon troubled waters. The inventor has relied upon the protective power of these two agents to produce around a stranded ship a zone of safety. He proposes to surround the stranded ship with a floating breakwater and to cover the water between the ship and the breakwater with oil. He expects, thereby, to produce around the ship an area of comparatively still water, sufficiently large to prevent the heavy sea outside of the breakwater from reaching and destroying the ship.

Around the ship, at a reasonable distance is placed a barrier of logs or cylinders of copper or aluminum netting filled with cork. These logs are to be strung on a cable and anchored by cone-shaped weight anchors with claws or prongs which are supposed to take a firm hold in the bottom of the sea. To the logs pipes connected by flexible joints and provided with nozzles are attached. This ring of pipes is connected with the ship by a supply pipe through which oil is conducted to them. Between that outer ring of logs with their attached oil-distributing pipes and the ship the inventor places another protective ring, consisting of frames so weighted, that they float in an upright position. These frames are attached to logs strung upon a cable and are flexibly joined together by heavy copper netting. This inner breakwater also is anchored in position.

Theoretically this double

breakwater should be efficient provided certain conditions are fulfilled. There are a great many "ifs." The area inclosed in the breakwater must be very large to produce any quieting effect upon the breakers. The breakwater must be securely anchored, otherwise it will be dashed against the ship and wreck it. But, even if we accept the theoretical possibility of the inventor's plan, its practicability seems extremely doubtful. It would require a great many logs to enclose an area sufficiently large to do any good and the ship would have to carry these logs, pipes and frames stowed away on the deck. They could not be placed in the hold because, like lifeboats, they are intended for an emergency which permits no delay. Another difficulty would be the launching of the breakwater in a storm.



Two concentric breakwaters produce a safety zone of smooth water around the ship if the angry billows permit

The Brassie Too Heavy? Then Take Out Some Weights

WHEN the golfer finds his ball in a good "lie," too far away from the hole flag for an iron shot and yet at such a distance that he fears he will overdrive by using the brassie—then is the time he should congratulate himself on having obtained a brassie with a device for lightening the club. This device is a container attached to the head of the club with space enough for weights. By removing a screw the container can be removed from the club and the weight or weights taken out, thereby reducing the force with which the club strikes the ball and enabling him to attain his object.

A brassie that's heavy or light as weights are inserted or removed from the container in the club's head

The Importance of Snugly Fitting Piston Rings

WHILE the soul of an automobile is naturally its engine—the vital spark that keeps it going—the piston rings are its heart and lungs. If the cylinder is not absolutely air-tight, it is faulty and fails to develop to the utmost the power furnished it. Piston rings are designed to make the cylinder air-tight, and their important function is thus explained.

When gasoline explodes in a leaking cylinder, a certain amount of its explosive power is wasted, whereas in an air-tight cylinder the entire force of the explosion is utilized.

The exploding gases in a cylinder develop an intense heat—about three thousand degrees of Fahrenheit. If the piston rings are not capable of responding to the expansion and contraction that result from such repeated influences of great heat, they will soon be incapable of giving good service. A ring made in one piece is most likely to have the proper qualities, if made of well-tempered material, hammered on the inside to give it greater strength and resiliency.

Since the cylinder is round, it stands to reason that the piston ring ought to be round also. If it is not, it is like the square peg in a round hole.

The motor that works only indifferently well with ill-fitting piston rings may work to perfection with rings that are accurately fitted. Concentric rings insure uniform pressure to all points and utilize to the full the explosive charge of the fuel-gas.

A Sure Enough Mowing Machine for the Hair

"NEXT!"

The hirsute backwoods man, who had been dozing in one of the chairs over the dilapidated pages of a pinkish periodical, arouses himself, walks over to the just vacated barber-chair and with a yawn settles down for another snooze.

"Haircut and shave!" is his laconic order to the barber.

Giuseppe languidly rolls a little stand to the chair, grasps a mysterious instrument connected with the stand by a flexible tube and turns a switch. A humming sound is heard, which seems to come from the instrument in the barber's hand.

The man in the chair, who had been watching the barber's doings with growing suspicion, is now fully aroused.

"Not much!" he says, as Giuseppe approaches him with the mysterious instrument. "I don't want to be electrocuted or have holes drilled in me!"

It took some lengthy explanation to convince the suspicious backwoodsman that the barber had no designs upon his life, but merely wanted to cut his hair with one of the new-fangled rotary cutters.

The tool shown in the accompanying illustration is the invention of Manfred Petrella, of Buffalo, N. Y. It consists of spirally curved pivoted blades revolved in a conical casing. The principle of the device is precisely that of the familiar lawn-mower. A movable guard permits adjustment of the distance between the cutter and the skin and a receptacle is provided to catch the hair as it is cut off by the revolving knives.

Yes, you can cut hair like grass now with this machine

You wind in and out on the famous Chimbatti loop of the narrow-gage railroad to the mountain resort of Darjeeling, in India

Cork-Screwing Up the Himalayas to Darjeeling

ONE of the most interesting railroad lines, the construction of which meant the solution of difficult engineering problems, is the narrow-gage railway which winds its way up the steep slopes of the Darjeeling range of the Himalayas to Darjeeling.

Darjeeling is a noted health resort of the British rulers of India and the summer seat of the Bengal Government. It is 7,400 feet above sea level. Its delightful climate and the magnificent scenery surrounding it, including a panorama of the highest peaks of the Himalayas, make it one of the most desirable places in India during the hot season. One of the remarkable features of the mountain railway is the Chimbatti loop, probably the only example of its kind in the world. The tracks, rising at a steep grade, make a complete double loop to reach the station on the mountain top.

With meat soaring to prices that only a Rockefeller can pay, who knows but we may be eating seaweed soon?

Learn to Like Seaweed. It May Become a Popular Food

ROCKWEED soup, rockweed omelet and rockweed pie may soon be found on the table of the housewife who is alert to obtain nutritious and inexpensive food. A considerable variety of edible seaweeds, of which rockweed is one, can be found along both the Atlantic and Pacific coasts of this country. Japan has been awake for some time to the value of seaweed as a food and the United States is now beginning to realize its worth. In Maine rockweed is being gathered in large quantities and prepared for market.

Peanut Flour as a Wheat Substitute

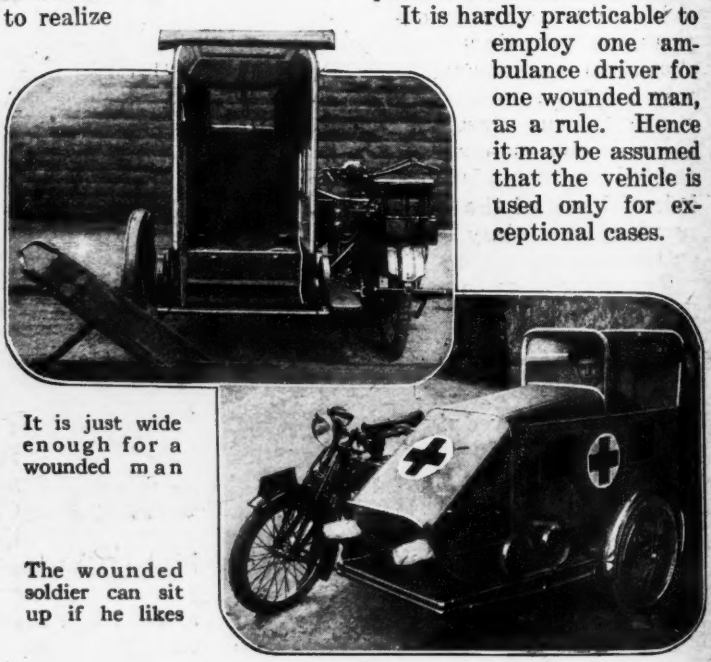
A BAKING company in Gainesville, Fla., has put bread in the market which is made from peanut flour. The flour is made from peanut cake left after the extraction of the oil. It contains a satisfactory percentage of fat and is said to have almost twice the nitrogenous food value of dried beef.

Chauffeur and Nurse, Too, Is the Ambulance Driver

THE French Government has adopted for the use of the army a side-car ambulance, which, in many respects, is superior to the other types heretofore used. It is built of light material and is large enough to accommodate but one stretcher. Windows with removable curtains are provided to enable the patient to look out while lying on the cot or stretcher. The cot can also be so arranged that the patient may sit up. An electric bell connects him with the driver of the motorcycle, who also acts as nurse.

One considerable advantage of this type of ambulance is that patients may be transported in it while sitting or reclining and that they can obtain not only all the sunlight and fresh air they desire, but also an unobstructed view of the country through which they pass on their way to the rear. No extra attendant is necessary except in cases where the patient needs close attention.

It is hardly practicable to employ one ambulance driver for one wounded man, as a rule. Hence it may be assumed that the vehicle is used only for exceptional cases.



It is just wide enough for a wounded man

The wounded soldier can sit up if he likes

The Bacterial Inhabitants of Ice-Cream

THE population of the United States is approximately one hundred millions; the bacterial population of one cubic centimeter of ice-cream is 37,859,909, or about six hundred and six millions to a cubic inch. That makes quite a crowd of bacteria in a glass of ice-cream soda. But don't be afraid of your ice-cream on that account, for most of those bacteria are harmless, and many of them are actually helpful, enriching the gastric juice by adding to its digestive properties.

A Ducking Goes with an Automobile Ride in This Park

AUTOMOBILISTS who visit Rock Creek Park in Washington, D. C., find it necessary to ride through the creek after which the park was named instead of over it. This is due to the fact that the engineers in laying out the park were careful to preserve, as far as possible, all of the natural beauties of the place. Therefore they decided, instead of constructing bridges across the creek, to build fords, which were more picturesque as well as more economical.

That part of the road-bed which runs through the creek is built of cement. It is wide enough for two machines to pass, its boundaries being indicated by rows of boulders which project above the water. When the cars pass through the creek at good speed the water is thrown up in wall-like formations and the occupants of the automobiles receive a wetting. However, if the machines maintain a speed of about four miles an hour the involuntary ducking can be toned down or avoided.

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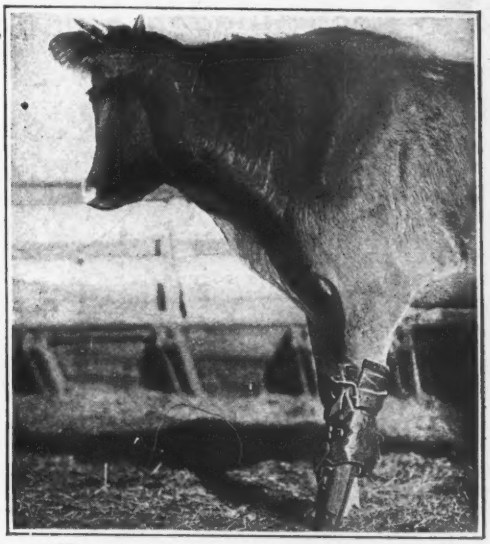
They are running in water, and yet they are on a road—a cement road under water which constitutes a ford



When a cow or a horse breaks a leg the farmer usually grabs his gun. But what's the matter with wooden legs?

Here's a Cow That Walks About Despite a Wooden Leg

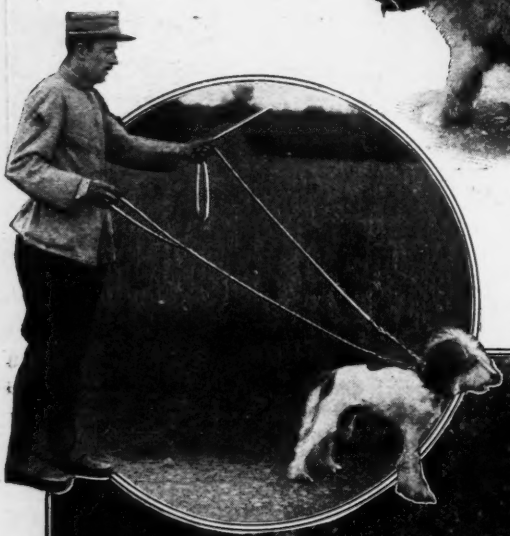
THAT a broken leg need not be a handicap to the bovine species has been demonstrated by a valuable cow which was found on the ranch of A. C. Chafin, near the town of Temple, in Texas. A corn-planting machine was the means of accidentally breaking one of her legs and her owner substituted therefor a wooden member. It fits so well that she walks about with the same ease that she possessed before the accident occurred.

This successful surgical operation will no doubt suggest to other farmers the feasibility of saving their cattle when they are similarly injured.

This cow's milk is as good as ever in spite of her accident and her artificial but serviceable leg.

Training Intelligent Dogs to Lead Blinded Soldiers

The dog has two collars, each with a leash, and one having blunt spikes on its inner surface which arrest the dog's attention sharply but do not injure him



Teaching the dog to avoid leading the blind man between two objects too close together to permit the man to pass through with ease

Leading his master through a group of bottles. Major Mairic of the French Army is the originator of this method of teaching man's faithful friend to be a help to blinded soldiers

How Injured Soldiers Are Carried

The wounded comrade is carefully lowered to a sitting position, his armpit catching on the knee of his carrier who can then change the position of his own arm and legs in lowering the wounded man to the ground

Reaching through with his left hand, the rescuer pulls up the free leg of the injured man, most of the weight then resting on his neck

© Photos by American Red Cross

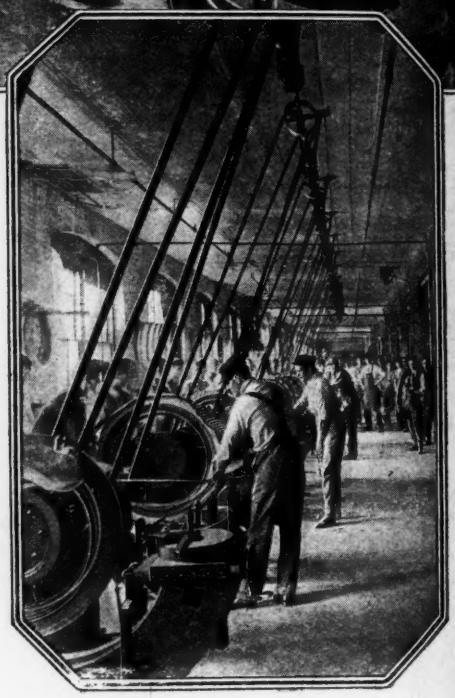
Effective carrying position, also employed by firemen. The problem is to put down the patient on the ground at the dressing station

The only way for a soldier to carry a wounded man and still have his hands free to fight is shown above

The injured man is slung over the shoulder and held by his coat tail

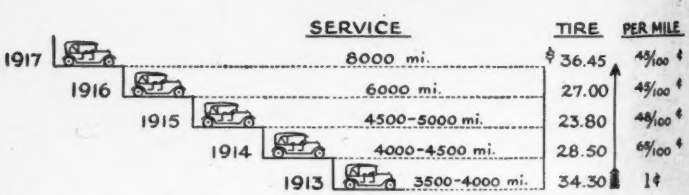
Your Automobile Tires Are More Costly Now

We ride on air imprisoned in a rubber tube which is strengthened with threads of cotton



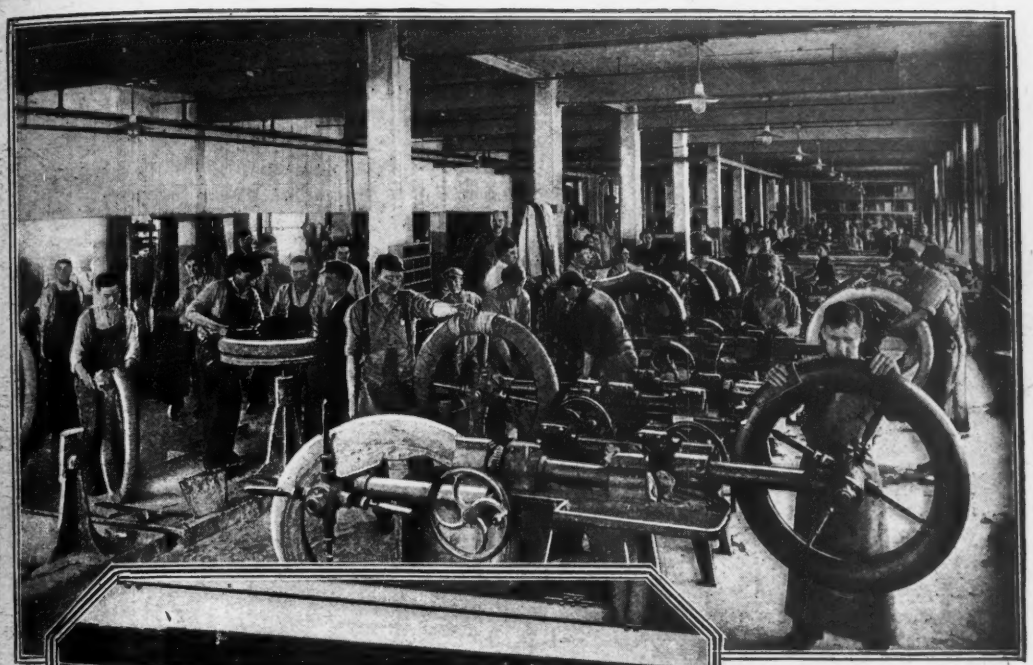
Rubber "biscuits" are the raw material as it reaches the manufacturer

A good tire must have a good tread—the surface which rolls on the ground

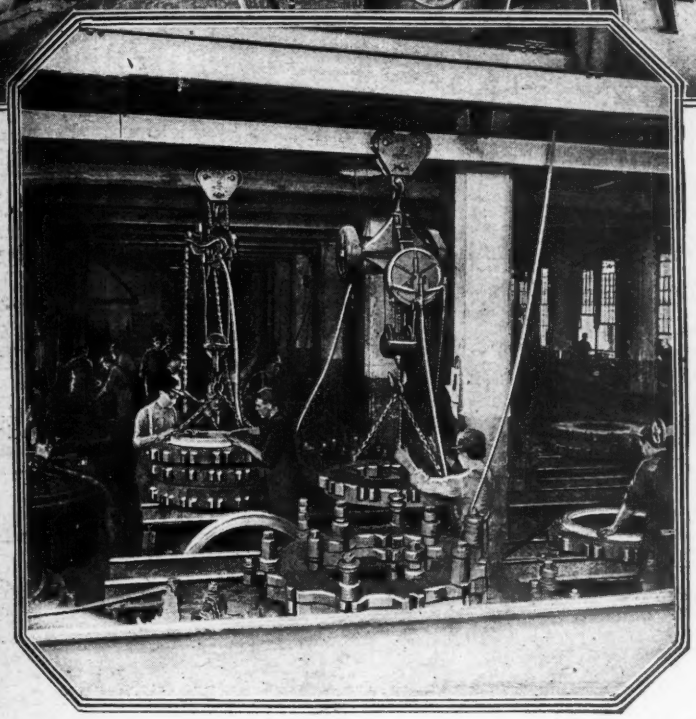


Though the cost of tires is greater than in 1913, it is offset by the increased mileage

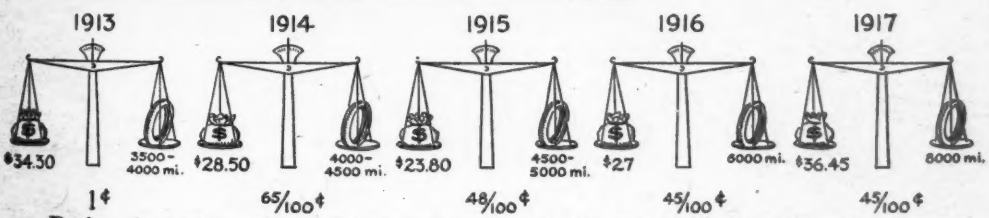
But They Are Giving You Greater Service



Cotton fabric is the one material without a substitute for building the framework of the tire. Tire cost per mile is kept down by a good fabric

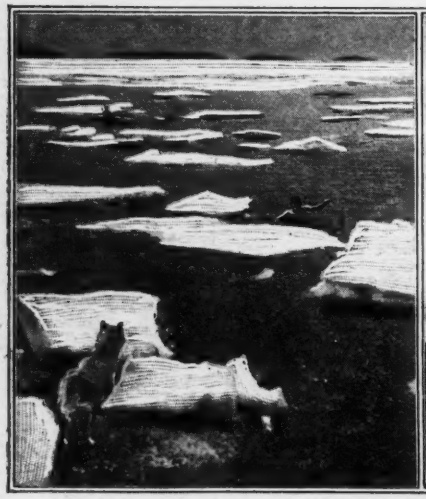


Vulcanization—applying heat under pressure—gives the tire strength and serviceability. The sulphur chemically reacts with the rubber, making a resilient substance

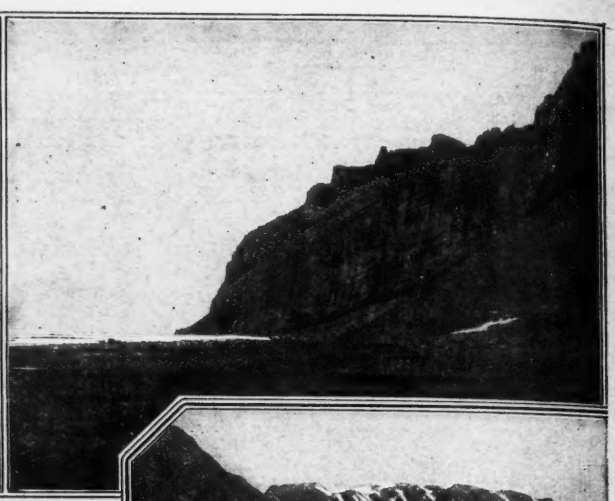


During the last five years, the gradual increase in the cost of tire production has been nearly balanced by greater tire efficiency, so that cost per mile is still under one cent

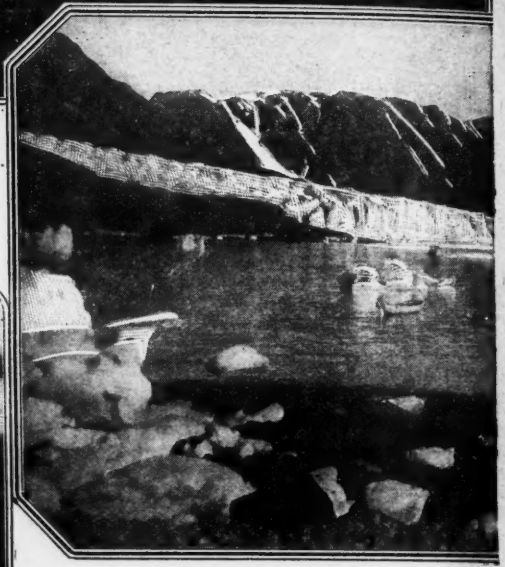
Among Greenland's Icy Mountains the Birds



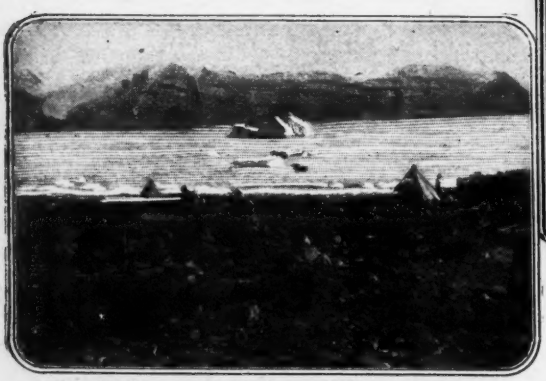
No wonder the dog is looking with some astonishment at a man bathing in icy water. This really happened near Etah, Greenland



Where countless birds nest among the cliffs at Okrah, northwest Greenland, during the hot summer months



When you see an iceberg in the Atlantic Ocean, the chances are that it broke off from a Greenland glacier.



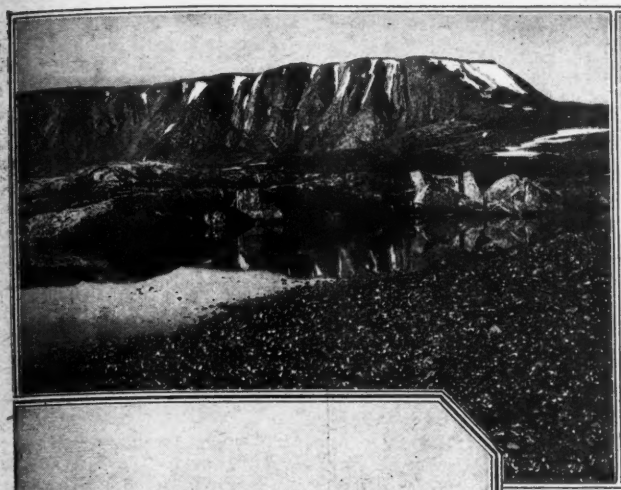
MacMillan and his expedition camped on the shore of a deep inlet on the northwestern coast of Greenland. See the tent on the right

The eider duck uses her down to make a comforter for her eggs

Etah is the place we have selected for the Popular Science Monthly's summer office. It is in northwestern Greenland

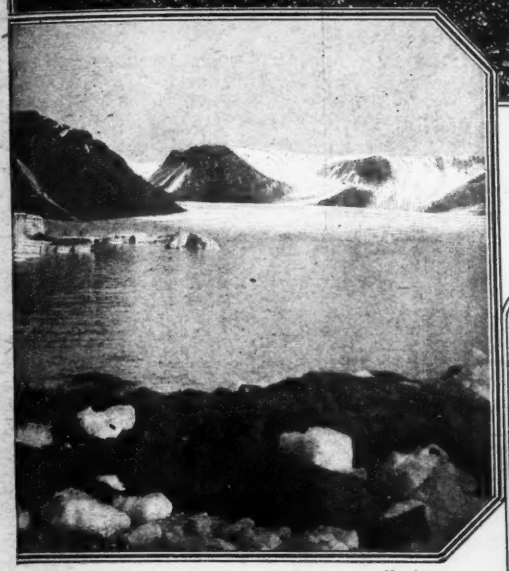
© Photos by D. B. MacMillan, Leader of Crocker Land Expedition. Courtesy of American Museum of Natural History

Twitter and Flowers Bloom in Summer



No wonder they call this Surprise Point. Millions of poppies bloom here in summer. See foreground of picture above

This cairn was built by Peary at Camp Thomas Hubbard many years ago. Ensign Green is standing beside it



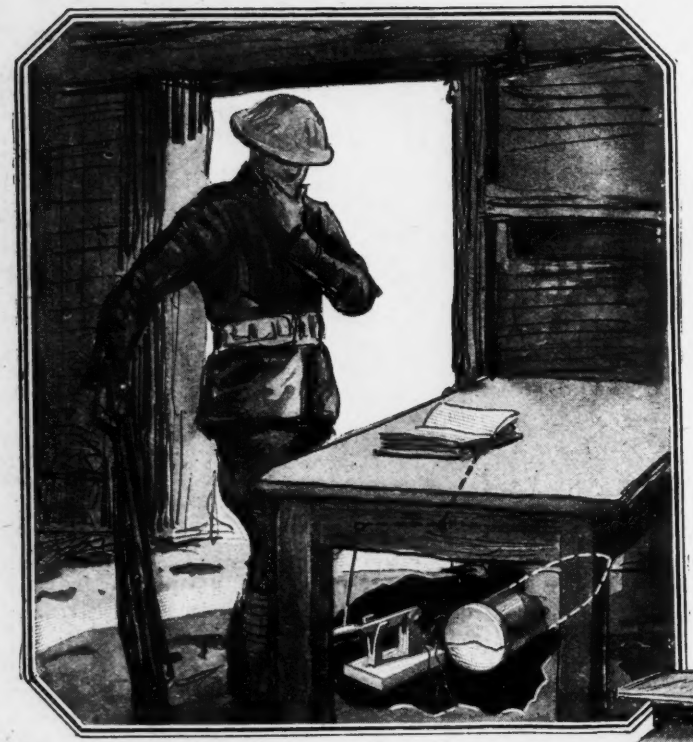
This particular mass of ice is called Sonntag Glacier in northwest Greenland

After three years the MacMillan Expedition still had 30,000 pounds of biscuits left. Mr. Hoover ought to send his congratulations

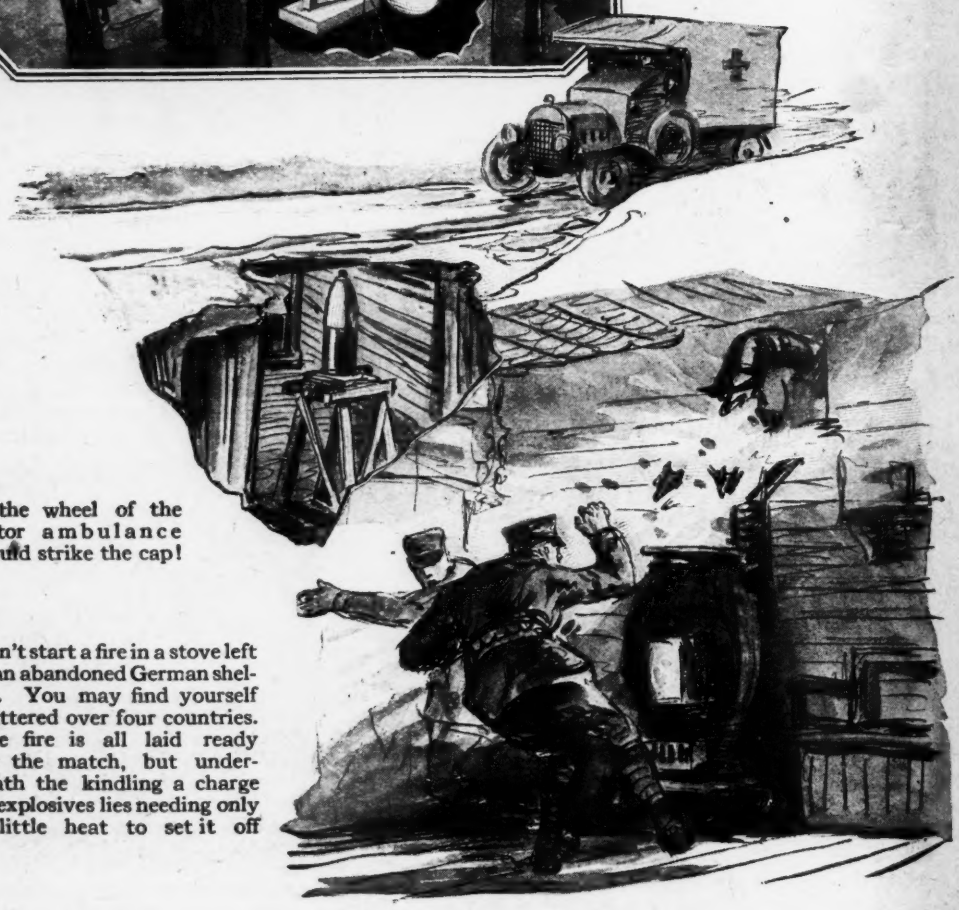
MacMillan had all the excitement of an Arctic picnic though he went for the purpose of exploring an unknown land

Greenland is not all ice and snow. These flowers prove the contrary

Camouflaging Death. The German Lure



Shall he lift the book or shall he not? No wonder he lays a doubting hand on his chin. If he has not been warned to be on the lookout, or if he lets his curiosity get the better of caution there will be another casualty to report. Cunningly concealed wires lead from the innocent looking volume to a death-dealing explosive



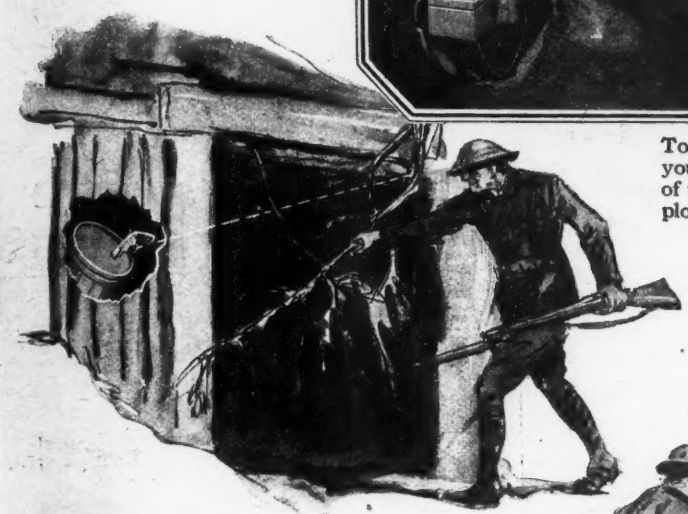
If the wheel of the motor ambulance should strike the cap!

Don't start a fire in a stove left in an abandoned German shelter. You may find yourself scattered over four countries. The fire is all laid ready for the match, but underneath the kindling a charge of explosives lies needing only a little heat to set it off

to Suicide Left for the Unwary

Eternal vigilance is the price of safety when our men move into towns or trenches abandoned by the Hun, To pick up a helmet for a souvenir is to invite death; if a board offers a most convenient bridge across a ditch it is probably a death trap, and the grandfather's clock in an old farm house may be the timing device for an infernal machine. Our soldiers have been schooled to detect and avoid these devices

Touch that shovel, Bill, and you die. The spring members of the clip will meet and the explosive will be electrically ignited

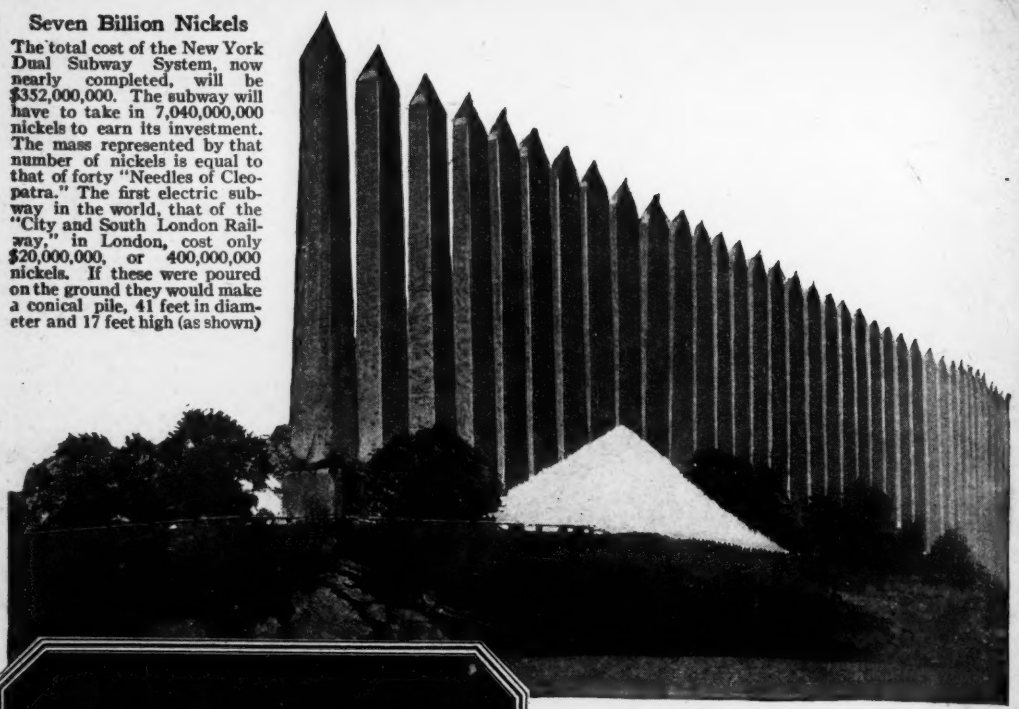


That artfully drooping tree branch—touch it not. The trigger of a loaded pistol will be pulled if you do, and a keg of explosives will be set off. This was one of the first devices adopted by the Germans when they introduced the art of the camouflage of death

Look out for the house that has miraculously escaped destruction. If you walk up the steps, you are sure to touch a concealed cartridge cap and go higher than you wish

Seven Billion Nickels

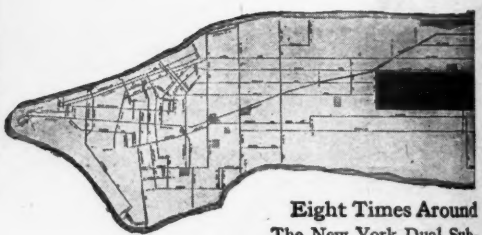
The total cost of the New York Dual Subway System, now nearly completed, will be $352,000,000. The subway will have to take in 7,040,000,000 nickels to earn its investment. The mass represented by that number of nickels is equal to that of forty "Needles of Cleopatra." The first electric subway in the world, that of the "City and South London Railway," in London, cost only $20,000,000, or 400,000,000 nickels. If these were poured on the ground they would make a conical pile, 41 feet in diameter and 17 feet high (as shown)



These Stupendous of New York City's

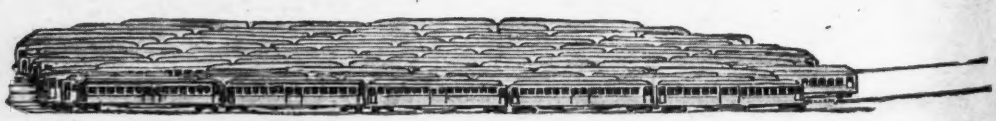
More Bewildering Figures

The trains of the New York Subway make a total of 109,500,000 miles in a year. A track of that length would go fourteen times around the earth, then to the sun and six times around the sun. The total mileage of the trains of the London Subway is only 589,401 miles in a year. That would be equal to the distance to the moon and fourteen times around the earth

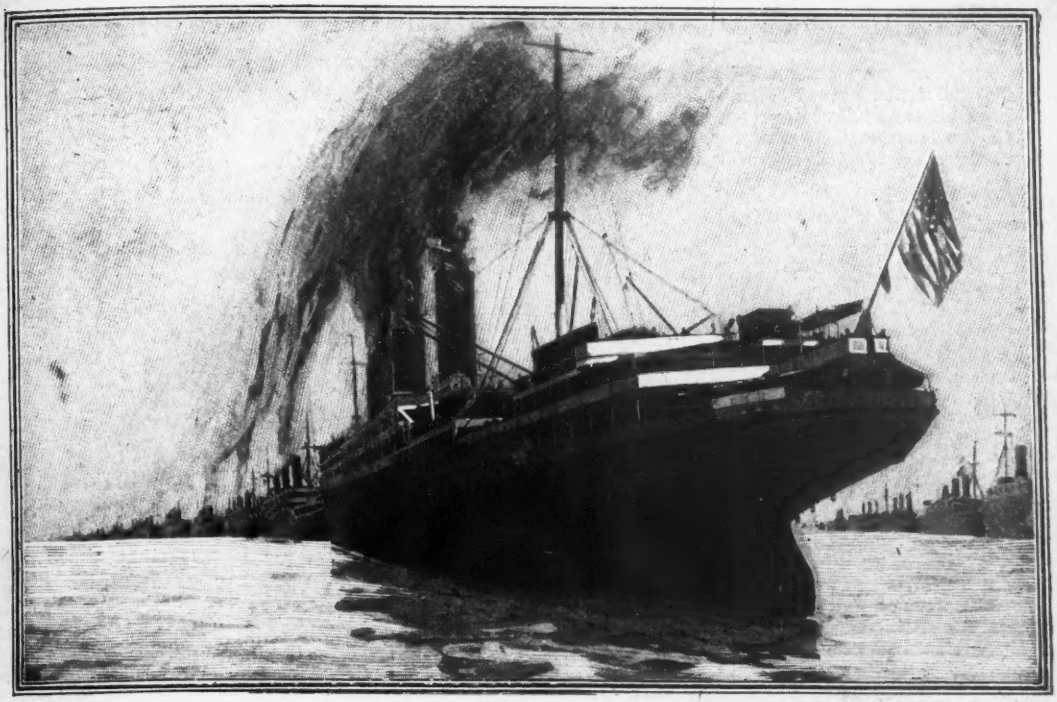


Eight Times Around

The New York Dual Subway will have 260 miles of single track. A track of that length could be wound around Manhattan Island eight times. The City and



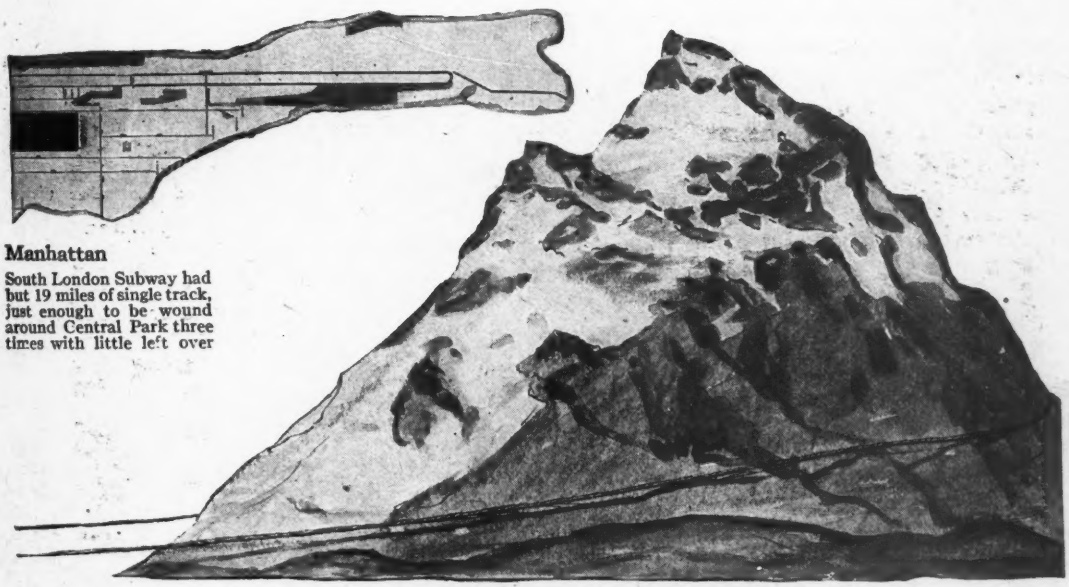
The total amount of energy expended by the New York Subway System since its opening, October 27, 1904, would



Figures Tell the Story Great Subway System

Can You Imagine It?

The New York Subway System, when completed, will be equipped to transport 3,000,000,000 passengers a year. To carry that number of passengers across the ocean would require 2,200 steamships of the size of the "Leviathan" every day. The first London Subway carried only 10,225,987 passengers in the course of a year



Manhattan

South London Subway had but 19 miles of single track, just enough to be wound around Central Park three times with little left over

have been sufficient to move Mount McKinley, the highest mountain in North America, a distance of 75 feet

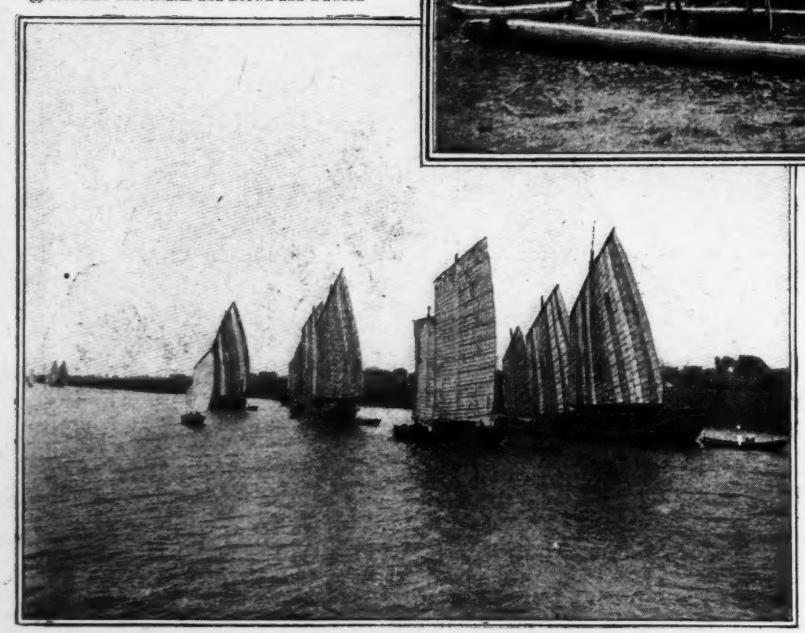
Speaking of Our Shipbuilding Programme, Let's

To the right: In the Sampan villages on the river near Colombo, Ceylon, many of the natives and their families live all the year round

In such frail craft the Shanghai fishermen venture out far on the ocean. It is a type of ship which is centuries old

Below: Chinese salt junks slipping along lazily on the Yangtse River. The sails are made not of canvas but of bamboo leaf matting

© Newman Traveltalks and Brown and Dawson



Above: When a Chinese junk is built no elaborate staging or framing is used or required

Look at Ships in Other Ports of the World

Of course the Chinese must have a "dragon boat." It is a type common on the Yangtsekiang and other rivers of China. It is crude, yet capable of carrying considerable loads

West Indian natives paddle their queer little boats with their hands

The fishing boats of the natives of Ceylon (shown below) have outriggers to prevent their capsizing in squally weather and a heaving sea

Fishermen in Hawaii are very daring and often venture far out in primitive outrigger-boats like that shown in the picture above. These boats have remarkable stability and power of resistance to the elements

Trinidad Chocolate for You and Me

© Newman Traveltalks and Brown and Dawson

When ripe, the beans are fermented by covering them with banana leaves for about two weeks

Cacao fruit looks as if somebody stuck it on the tree. It is purplish-yellow, seven or eight inches long and contains from twenty to fifty seeds. Ecuador, Trinidad, Brazil and the West Indies yield most of the world's cacao bean output

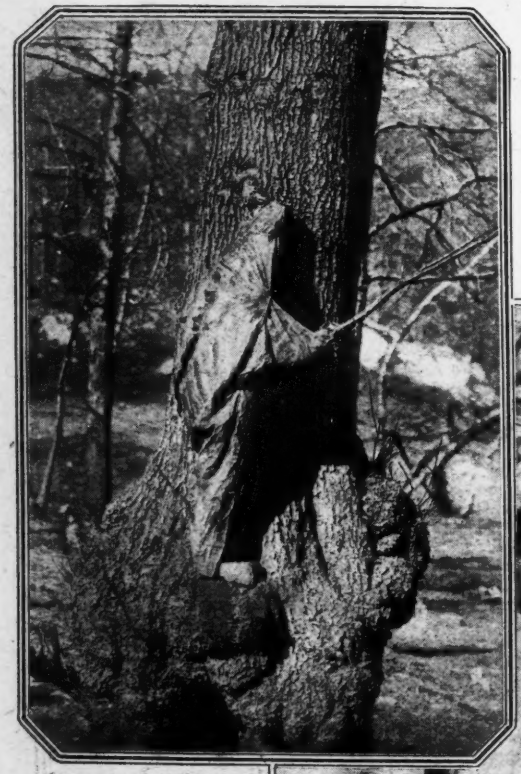
Then the beans are dried in the sun. Native feet kick the heaps into a thin bed to dry them faster

Hats are Really Sunshades as Worn in Malta and Korea

Women of the better class on the island of Malta have part of their cape stretched over a wire frame and use it as head covering to shade the face

In Korea it is a disgrace to be in mourning and for that reason the pedler in this picture wears a big basket-shaped hat

Taking Lessons from the Chameleon and the Moth



© Underwood and Underwood

The soldier in his camouflage costume bears enough resemblance to the tree trunk in front of which he stands to deceive the most astute hostile airman that flies over

To mimic a tree trunk to perfection is an art that has to be learned. The New York Board of Education has established classes for war camouflage, to teach that art

How the Gentle Art of Camouflaging Is Taught

No actor could play his part in a drama more skilfully and convincingly than the soldier in this picture plays the part of a rock. Do you think you could detect the camouflage in that mass of grayish rocks?

On Broadway a man dressed in this costume would be conspicuous enough to draw a crowd, but put him amongst rocks and trees and he will merge in the surroundings, becoming invisible

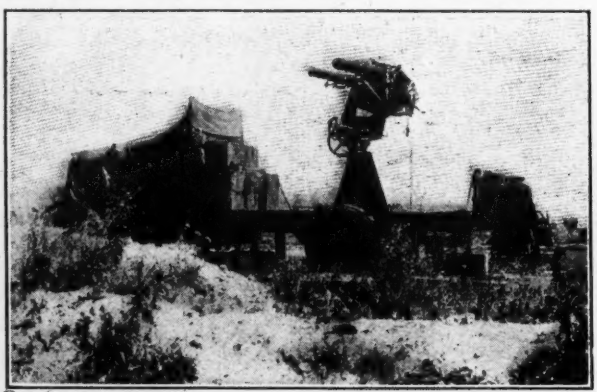
The members of the camouflage classes receive practical instruction in the principles of the art of war mimicry and are trained in the best methods of fooling the foe

Gunning for Bird-Men

Some recent anti-aircraft guns with improvised mountings

By Carl Dienstbach

THE art of war has reverted to a state similar to that which the introduction of the use of gunpowder and firearms produced in the fifteenth century. Then, conditions and methods had to be readjusted to meet the changes produced by a new and powerful agent of destruction, not yet fully understood; now, new means of warfare, evolved by the marvelous resources of modern science and engineering, have again unsettled conditions and caused an upheaval upon a fearfully exaggerated scale.



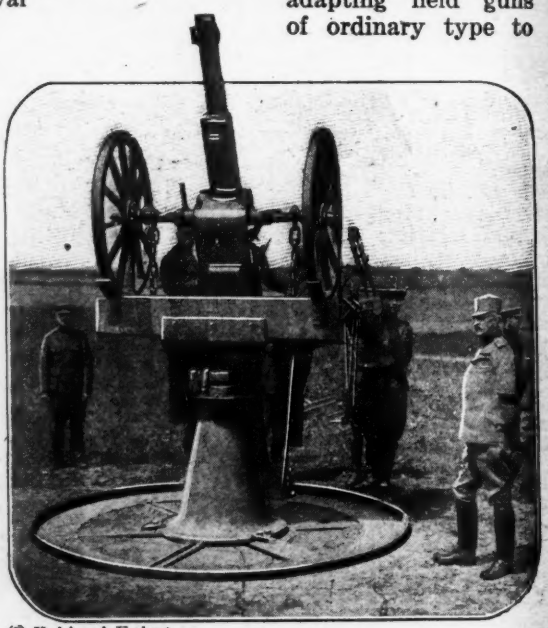
© French Pictorial Service

The Belgians mount field guns on improvised revolvable platforms to be used as anti-aircraft guns

As in the fifteenth century, infantry and artillery had to be armed with makeshifts—hand grenades and ponderous bombards, improvised under the very stress of battle. The chief importance of infantry is once more in its bodily impact; the rôle of artillery is again to smash and overwhelm everything by enormous projectiles.

When it was found necessary to use the heaviest naval and siege guns with the least possible delay, mounts had to be improvised, which bear a curious resemblance to bygone makeshifts. Even of the lighter cannons, of smaller caliber, many have undergone a curious metamorphosis which makes them resemble the medieval "falconets" which occasionally had to be pointed skyward to reach the enemy's scouts stationed on the watchtowers of castles perched on lofty crags. These modern guns also must be pointed toward the sky to fire at the enemy's scouts seated in airplanes.

Several standard types of anti-aircraft guns were invented, but so enormous was the increase in the number and activity of military airplanes and other aircraft, that the supply of standard anti-aircraft guns could not keep pace with the demand. It became imperative to improvise such guns by adapting field guns of ordinary type to

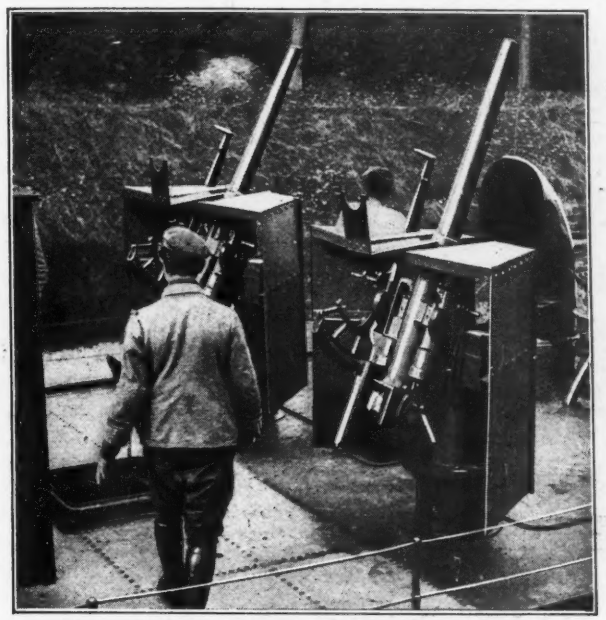


© Kadel and Herburt

A British gun, mounted on an automobile truck, can be used horizontally as well as vertically

the requirements of high-angle firing. Some of these improvisations are shown in the accompanying illustrations.

Field guns of regulation type were mounted in different ways, but always so that they could be aimed vertically as well as horizontally or, changed from one position to the other with the least possible difficulty. In the case of the Belgian gun shown in one of the pictures the complete field gun, with its carriage, tail and all the rest has been chained to a column with a revolving platform. Only the barrel with its recoil tube has been utilized to adapt the gun for the automobile truck. But note the ingenious fork in which the gun is mounted. It gives the gun a complete horizontal firing circle, and, at the same time enables it to be pointed vertically with the greatest ease. This result has been achieved by constructing the fork so that it supports the barrel at a considerable distance from the base column upon which the fork is pivoted. Hence it is possible to stand right beneath the breech of the gun and to aim it as conveniently as one points a fowling piece.



By a rather crude improvisation the deck guns on this small French torpedo boat in the Aisne Canal have been adapted for use against aircraft

Twin guns are shown on a French torpedo boat, small enough to enter the Aisne Canal. That the guns are, primarily, intended to form part of the boat's armament against an enemy on shore or on water is apparent from the gun shields which give protection only against projectiles fired from approximately the same level. By a few changes in the gun shields and other details these guns have been adapted for use against aircraft, if the emergency should arise. That this adaptation is purely an improvisation is shown by the fact that the breech of the guns, when they are pointing vertically or nearly vertically, is so close to the deck that it is extremely difficult to aim them.

In contrast to the fixed gun, which can be used only against aircraft, the gun on theautomobile and the deck guns on the torpedo boat can be used at any angle desired.

Launching Seaplanes from Ships

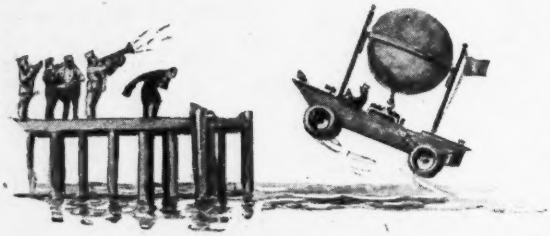
WHEN a big seaplane is to be launched from the deck of a ship (of whatever type) it is first "tuned up" on the launching stage. Then the ship is swung dead into the teeth of the wind and put at full speed. To make sure of the direction of the wind, for an error would mean a "crooked" run and, perhaps, the destruction of the seaplane, a jet of steam is sent up in the exact center of the extreme tip of the launching stage. When the back-blown steam streams straight along the middle plank of the stage, the wind is "right.

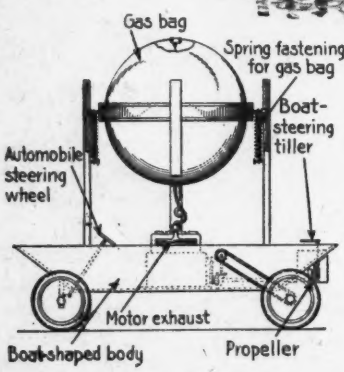
At a signal by the captain the pilot starts his engine full speed, while two mechanics, braced against cleats on the deck, hold back the tugging seaplane. When the "tone" of the engine is right, the wing commander brings down his flag with a sharp jerk, falls on his face to avoid a collision, and the machine, freed from the grip of the men holding it, jumps away into space from the launching stage. If everything was right, when the seaplane started, its flight will be comparatively free from risk.

The Jelaliplane and the Mitromudscow. In Both the Balloon Figures

HAVING become a free American citizen, far from bloody Turkish massacres and the homelike Mount Ararat, a famous dry spot in the times of Noah, and having settled at Cranston, Rhode Island, where surfaces of water abound, Martin Jelalian has bethought himself of means for walking upon occidental Galilees. And so he invented the Jelaliplane. Probably his indomitable spirit could not brook the thought of walking around them or of using a skiff. Mr. Jelalian insists upon walking, especially walking "slidably" and "erectly," which means without lifting his feet or stooping over. He patterns after snowshoes or skis but finds it needful to employ one balloon and one tilted aeroplane for assistance in the desired movement. With these aids he accomplishes his purpose, he says, in his patent, in a most safe and successful manner, from which assertion it may be inferred that he has not tried any water surfaces which are more than four inches above the bottom.

His airplane is a hoop, with wire netting (to resist the awful thrust) and canvas, slantingly placed in the ropes between the balloon and the doughty water-walker's head. It would serve nicely as a halo, had it not been for the inventor's thoroughness in attaching two air-filled cylinders to the hoop so that it may be used as a lifesaver if the balloon collapses. The footboards have airchambers underneath them and these share honors with the aeronautic devices in affording the needed support. Neglecting nothing that the most carping critic might point out as desirable, the inventor also provides an aquatic alpenstock, with buoyancy cylinders, and this he holds in front of him as a carpet sweeper.





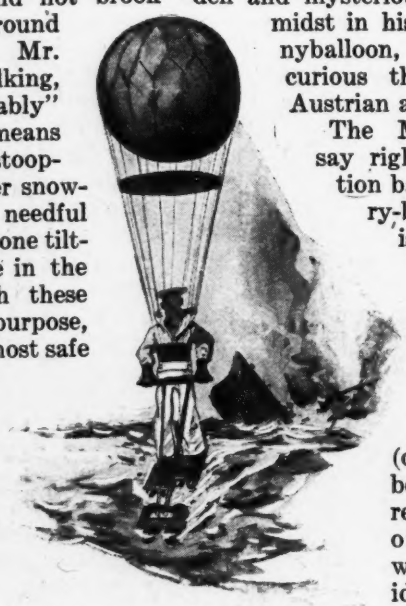
The Mitromudscow is a combination balloon and automobile, ferryboat and mudscow and is named by the Popular Science Monthly after its inventor, Wozny

If you care to study the details of the Mitromudscow's construction, here they are at the left

But Martin Jelalian, bold as he is, is totally eclipsed by Mitro Wozny, a subject of Austria, but not at present so employed. Mitro can be found in Cuyahoga, Ohio, U.S.A. How he got there we can not say. It may be that one day the citizens of Ohio were stunned by his sudden and mysterious appearance in their midst in his Mitromudscow Woznyballoon, joyfully greeting the curious throngs with a strong Austrian accent.

The Mitromudscow, let us say right here, is a combination balloon, automobile, ferry-boat and mudscow, and is named after its inventor. On land it is fleet of tire. On water it is a veritable duck; in the air a dirigible balloon.

By scanning the illustration above (originally it was placed below, but it would not remain there on account of its buoyancy) you will obtain an excellent idea of Mitro's invention. The balloon, as you see, is inflated suffi-



Martin Jelalian has bethought himself of means for walking on the high seas

ciently to relieve the wheels of all weight. Thus friction is reduced so that the vehicle will tip-toe along. Mitro can describe his invention better than we. We give him the floor but interpolate a few parenthetical comments. Gentlemen, Mitro:

"It will be understood that when the vehicle is traveling over the land under the propelling power of the motor the bag may be filled to the desired extent with exhaust gas from the cylinders so that the bag will rise. (That boy's a bear on gases). It will be understood that the buoyancy of the bag partially supports the vehicle so that the traction wheels force the device over the ground, lightly contacting the ground and skimming thereover. (When do you think the war will end?) When the device is in water, the propeller propels the device while the body only lightly rests upon the water by reason of the buoyancy of the gas bag. If it is desired to rise above the surface of the land or water, the bag will be provided of sufficient size."

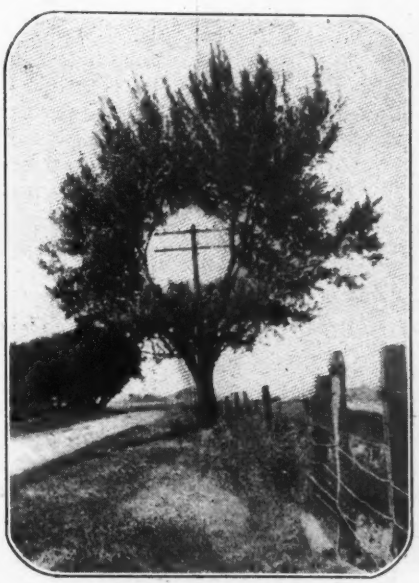
Alas, poor Newton!

A Tree's Foliage Trimmed to Let Telephone Wires Pass Through

ON the suburban lines of the Chicago Telephone Company, it has frequently been necessary to cut down trees or trim their foliage in order to give telephone wires the right of way. Foreman J. Woods, chief of construction of the local telephone company in Chicago, deserves credit for a novel method of overcoming the difficulties placed in the way of telephone-line construction by trees along the right-of-way. Our illustration shows how he trimmed the branches of a tree into a circle permitting the wires to pass through, yet not marring the beauty of the tree, but rather adding to its attractiveness by giving it the unusual appearance it presents.

The wires thus permitted to go through the tree were those belonging to a telephone line connecting Morris and Lisbon, towns in Illinois.

It is not usual for the minions of great corporations to display artistic tastes. When they do, we like to mention it.



A telephone company did it—not the Society for the Preservation of Trees

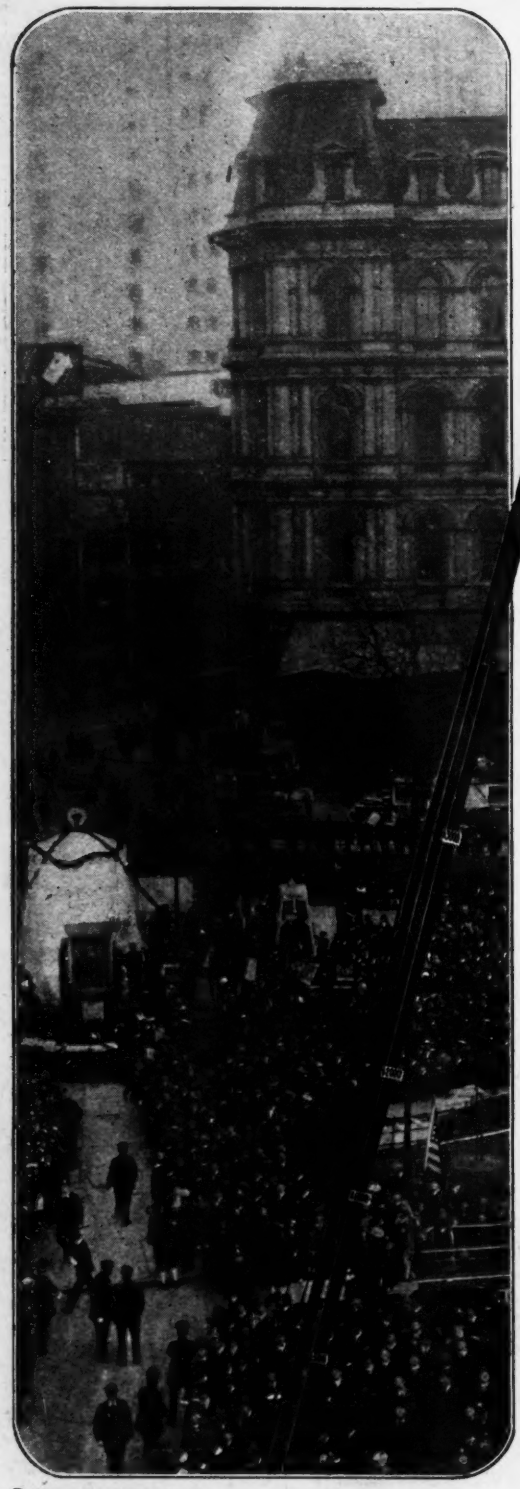
© Brown and Dawson, New York

These jugs hold no circus lemonade, nor water diluted with citric acid, but pure lemon juice

Who Cares for Whiskey or Beer When Fresh Lemon Juice is so Cheap

THE jugs nestling in the big basket on the truck shown above may arouse the suspicion in the minds of prohibitionists, but the suspicion is unjustified. The jugs, big and little, contain nothing stronger than fresh-made lemon juice. The scene is in Naples and the lemons may have grown in the garden of the enterprising vendor in the outskirts of the city. The Italians are very moderate drinkers. An Italian drunkard is a rare sight. Italians love their light wine, but consume it in moderation and quench their thirst during the hot summer time principally with fruits and fruit juices, especially lemonade and orangeade. Fruits and their juices are surprisingly cheap in Italy and the thirsty Neapolitans need not spend more than a few centesimi for a jug of the refreshing juice.

Here is a hint for our advocates of prohibition. Let them popularize fruit juices as thirst quenchers in fighting the Demon Rum!



© International Film Service
Each time the fireman moved a step nearer to heaven it signified the sale of a $50 Liberty Bond

Ascending a Ladder to Encourage Liberty Bond Sales

IF he had been dragging children from the top floor of a burning tenement house at the risk of his life, Owen J. Ryan, a fireman, could not have received greater applause than he did when he climbed to the top of a ladder in City Hall Park in New York during the last Liberty Bond campaign. The occasion was the celebration of Firemen's Day at the Liberty Bell booth in the park. Every time a $50 bond was sold Ryan stepped up a round, finally reaching the summit and waving the American flag. He made several trips, each one netting the loan fund $5,000.

Do You Know Why Grasshoppers Spit "Tobacco Juice?"

A FRENCH scientist, Dr. E. Rabaud, has unearthed the fact that the emission of dark fluid from the mouths of grasshoppers, when captured, is a swift action, which follows the stimulation of various spots of its skin. In other words, this carefree, joyous insect, when touched by the bad boy's or the naturalist's fingers on different localities of the surface of its anatomy, sets up a "reflex process" — a high-sounding name for a message from the skin to his spinal cord, relayed swiftly back again to a nearby muscle—between the skin and the throat of the grasshopper.

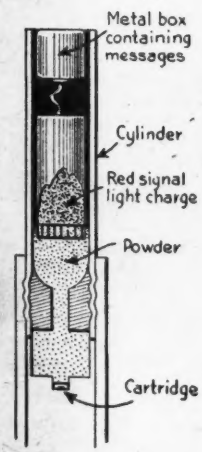
The abundance of the flow is determined by the pressure as well as the spot stirred up. The amount of the "juice" is increased if the sides of the creature's throat or its front legs are pinched.

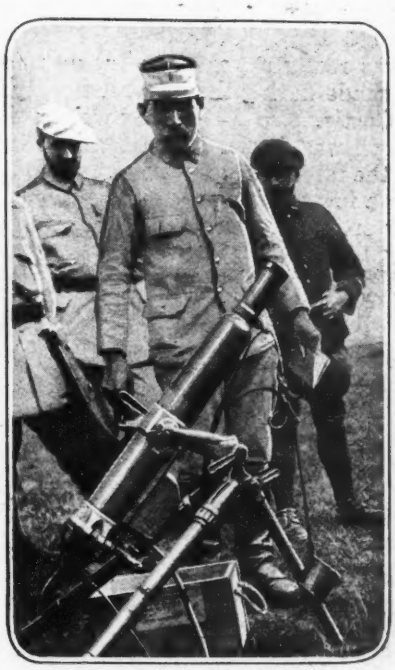
Dr. Rabaud found that the parts of the skin touched that make the tarry fluid come forth are different from the spots, which, touched, make the insect kangaroo jump. He, therefore, concludes that the surface of a grasshopper is divided up into groups of sensitive areas, one for jumping and the other for spitting.

Guns That Shoot Not Shells, but Messages to Commanders

THE transmission of messages, observations or directions from the first line trenches to the headquarters of the regimental or brigade commanders behind the lines is always difficult and attended with great risks. Of course connection by telephone is maintained whenever possible. Sometimes telephone and telegraph wires are shot away. Besides, the enemy may have tapped the wires and may be able to hear every word spoken.

The Germans on the West front have used several ingenious methods for overcoming these difficulties. The observers in the observation trenches in front of the first line enclose their messages in a cylindrical metal box and shoot it by means of a grenade-thrower or a mine-thrower to the rear of the lines. The accompanying diagram clearly shows the construction of the projectile used. To the box containing the message a red-fire cartridge is attached, which is ignited by the explosion of the sending charge, and by its vivid glare plainly marks the spot where the box with the message dropped. The grenade thrower, at an elevation of thirty-two degrees, sends the box to a maximum distance of six hundred yards.





The Germans on the West front shoot off messages with mortars

The canvas locker when made into a package and as it looks when securely closed

A Portable Canvas Locker for Use at Home or Abroad

PROTECTION for clothing not in use, whether in camp, in the home, in the factory or elsewhere, is made easy by a new portable canvas locker. The device weighs but five pounds, and may be carried under the arm when folded; yet when expanded it is fifty-eight inches high, twenty-two inches deep, and six inches wide. A mirror is set into one door.

As shown in the photographs on top, it holds a man's overcoat, coat, vest, shoes, and hat without crowding, and even has little compartments for a whisk-broom and a comb and brush. A padlock protects the contents against thieves. The canvas is impervious to dust and water. A name plate on the front, which cannot be removed from the outside, makes identification easy.

A Photograph Thirty-Nine Feet Long

A panorama of Naples, viewed from San Marino Castle, is the largest photograph ever taken

Photographs by Jacques Boyer

Retouching the mammoth photograph of Naples, after development

IN the May number of POPULAR SCIENCE MONTHLY was described a gigantic photograph of an actual battle scene, showing the storming of the Vimy heights by the Canadian troops on the morning of April 9, 1917. It was spoken of as being probably the largest war photograph ever made. It was really an enlargement of a snapshot made during the battle by Captain Ivor Castle.

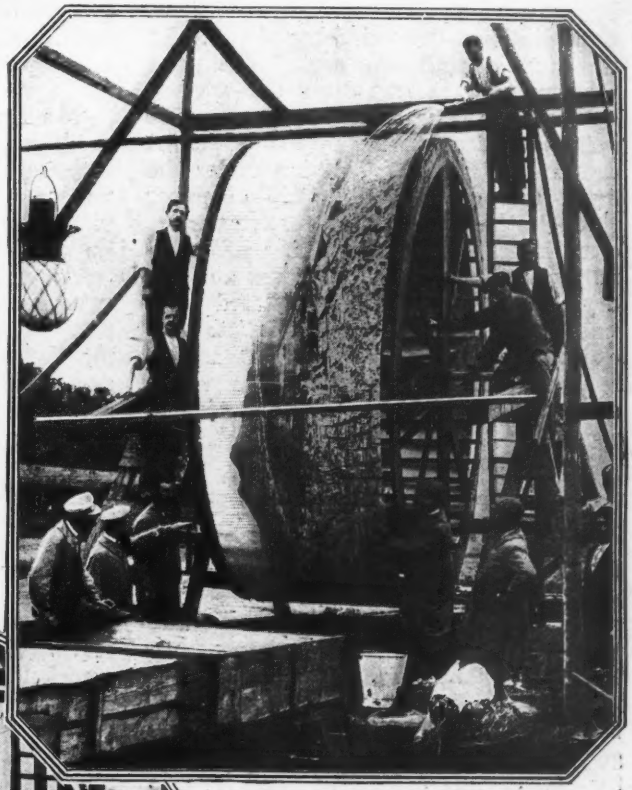
Large as that photograph was, it could not compare in size with the direct photographs which were taken a few years ago in the United States to advertise a western railroad line. To take these pictures, Mr. George Lawrence of Chicago constructed a gigantic camera, about six feet high and nine feet wide, which was mounted on a railroad flat-car. The bellows could be extended to a distance of about twenty feet. The weight of the camera was in the neighborhood of 1,400 pounds.

Later a German

A bromide enlargement was made on a strip of sensitized paper forty feet long by five feet wide

concern, at a public exhibition in Dresden, showed a still larger photograph. It was a beautiful panorama of Naples taken from the Castle of San Marino, with Mount Vesuvius and the island of Capri in the distance. The picture was about thirty-nine feet long and nearly five feet in height.

To obtain this panorama six views were made on plates, 8½ by 11 inches in size. The prints made from these plates were joined into a continuous print, and from this a bromide enlargement was made on a strip of sensitized paper nearly forty feet in length and five feet in width.



A wheel, 5½ feet in width and forty feet in circumference, was mounted upon a scaffold for developing and washing the print

To handle this large print special provisions had to be made. Three big vats for developing, washing and fixing were provided. They rested on flanged wheels running on a narrow-gage track. A wheel or drum, 5½ feet in width and forty feet in circumference, was constructed and mounted in a vertical position upon a scaffold.

The developing was done at night. The print was unrolled and slowly drawn through the developing vat, filled with an oxalate of iron solution. As the developed part emerged from the solution it was carefully inspected and all necessary corrections in the development were made by strengtheners or retarders which were applied

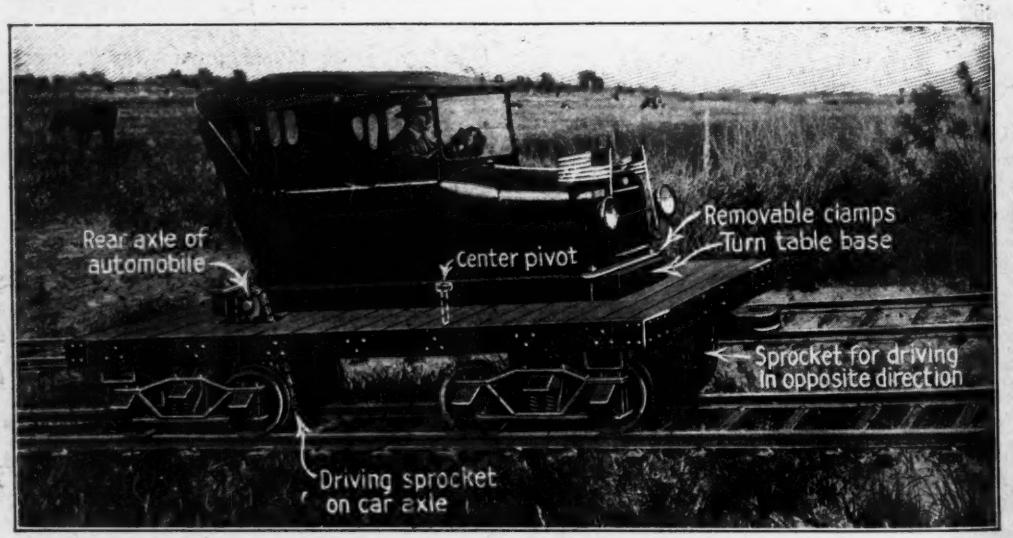
by means of sponges soaked in the respective solutions. The clearing of the print was done with acetic acid. The print was wound upon the drum and washed by a stream of water from a hose. The fixing was accomplished by rolling the vat containing the fixing solution under the drum and drawing the strip of paper through the solution for three quarters of an hour. The final washing with running water required eight hours and the drying ten hours. The completed print was turned over to several artists who skilfully retouched out any small imperfections and removed the lines which showed where the six plates were joined together.

Converting an Automobile Into a Railway Locomotive

SMALL steam locomotives such as those used to haul coal from the mines or timbers from logging camps are very difficult to purchase today. Even the second-hand market in such engines is exhausted because the equipment is being employed to carry on the many big government construction jobs. Orders for new engines cannot be filled for two or three years, because most of the locomotive factories are turning out equipment for our military needs and those of our Allies. Under such conditions, the method shown in the accompanying illustration for converting automobiles into such engines should find a wide range of employment—especially in the various mining sections of this country.

The truck consists of a small timber carriage somewhat like an ordinary railway hand car and mounted on four flanged wheels. The automobile to provide the motive power for the truck has its wheels removed and is then mounted on a platform or turntable which is supported on the carriage by a central pin. Chain sprockets are substituted for the rear wheels of the automobile and chains placed around them and the sprockets on the flanged wheels. The turntable mounting of the automobile permits it to be turned completely around, so that the radiator may always face toward the front to provide sufficient cooling for the engine water and to enable the driver always to look in the direction of travel.

When the car is to be turned, the driving chains are taken from around the sprockets on one pair of flanged wheels and placed on the other. The traction of all four wheels is secured by connecting the two axles by means of a chain running over sprockets mounted at the centers of the axles. The turntable supporting the automobile is held rigidly in place by means of two screw bolts through the platform and the truck frame.



How the automobile looks when converted into a railway locomotive. The chassis and engine are mounted on a truck. Traction is secured by connecting axles by chains running over sprockets

Even the Animals in the Zoo Must Now Hooverize

LIONS and tigers that used to feed on juicy beef are now glad to get a chunk of old horse. Snakes are satisfied with rats and mice—except the python, which still insists on tender pork. The bears get war bread made of wheat substitutes. The New York Zoological Garden raises a large amount of both vegetable and animal foods for its wild wards. On the whole, the animals take kindly to war-time economies, for, as yet, none has been heard to complain.

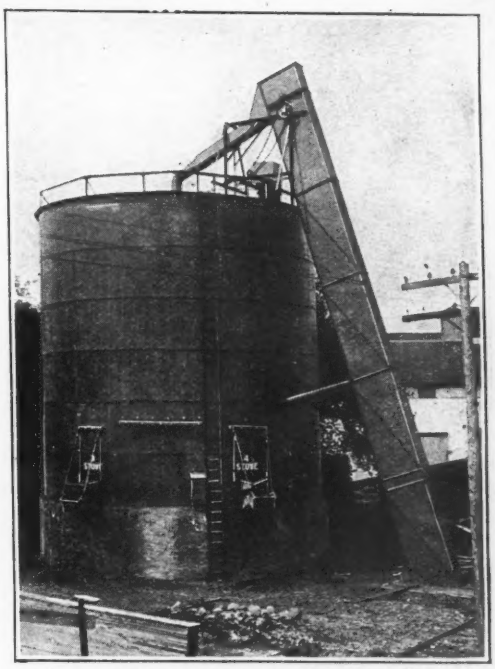
Working Under Forced Draft. Air-Cooled Overalls That Defy the Heat

AIR-CIRCULATING overalls have been introduced. Their object is to contribute to the farmer's comfort in hot weather. The garment works like a bellows, producing a draft. The harder the farmer digs or hoes the greater the draft.

On the front of the overalls is a bib, which is stiff and heavy. The sides of the garment are light and soft. When the farmer bends forward the front part of the overalls falls away from him, leaving a space which is filled with air that enters through an opening and emptying the space filled with air at the back of the garment. When the farmer straightens up again, the back fills and the front is emptied. At every step the air is made to circulate. The suit, therefore, is a kind of an air pump, operated by the moving body. Nothing is worn between the overalls and the skin, the clothing being kept away from the body by wires so that the draft may carry off the perspiration.

In order to obtain the full force of the draft, the sides of the garment are unbuttoned. Buttoning up the sides reduces the draft.

Puffed up not with conceit but with cooling air. His suit is a bellows which creates a draft around his body as he digs or hoes



A ton a minute can be loaded into this coal pocket which unloads automatically into wagons or trucks. The coal cannot be stolen

Here Is a Theft-Proof Coal Pocket with Six Bins

A NEW kind of coal pocket consists of a large steel tank built on a concrete foundation, and divided into six bins, which may be filled through one movable spout leading from the elevating device. By using an electric motor fifty tons of coal can be unloaded into the bins in fifty minutes. Their capacity is 750 tons.

The car dumps its load of coal into a pit from which an endless belt with the scoop pockets hoists the coal into each bin in succession. The bins are built with floors slanting outwardly so that wagons can be loaded by gravity.

The end of the rubber tube in the water contains a small piece of absorbent cotton which filters out impurities

Drink from the Brook—But with a Sanitary Drinking Tube

THREE little girls, on a picnic excursion in the mountains, prepare to eat their luncheon. First, however, they voice their intention of drinking from a spring near by.

One of them produces a rubber tube about a foot and half in length and one-fourth of an inch in thickness. Placing one end of the tube in the water and the other in her mouth, she kneels down to drink. Her example is followed by the others.

The end of the tube in the water contains a small piece of absorbent cotton which filters out impurities.

Keep a Toad in Your Garden and Save $19.88 Yearly

THE toad is useful because of its diet. No less than eighty-three species of insects, mostly injurious, have been proved to enter into his dietary. In his "Civic Biology" (American Book Company) George W. Hunter says: A toad has been observed to snap up one hundred and twenty-eight flies in half an hour. Thus at a low estimate it could easily destroy a thousand insects during a day and do an immense service to the garden during the summer. It has been estimated by Kirkland that a single toad may, on account of the cutworms which it kills, be worth $19.88 each season it lives, if the damage done by each cutworm be estimated at only one cent. Toads also feed upon slugs and other garden pests.

Drop in a Quarter, Turn a Crank, and Buy a Thrift Stamp

A MACHINE has been introduced which will provide a thrift stamp when the purchaser drops a quarter into a slot and turns a crank. The apparatus not only saves clerical work, but acts as a cash register on stamp sales. In order to make the machine ready for operation one hundred thrift stamps are placed in the bank in a small, compact roll. When the roll is sold there will be one hundred quarters in the cash box, and the automatic counter will indicate that one hundred sales have been made. The banks are to be found in stores, schools and factories.

Drop a quarter in the slot, turn the handle and get a thrift stamp

The Caravans of the Sea

Convoying ships through the danger zone

By Ernest Welleck

Landing under their own guns

WHEN Germany, shortly after the beginning of the world war, entered upon an intensive submarine warfare against all shipping belonging to the Entente Allies, the U-boat was a comparatively new and untried weapon. Step by step the submarine was developed into a most formidable fighting machine. Size, speed, dirigibility and radius of action were steadily increased. The U-boats became more efficient and dangerous, and the list of their victims increased at an alarming rate.

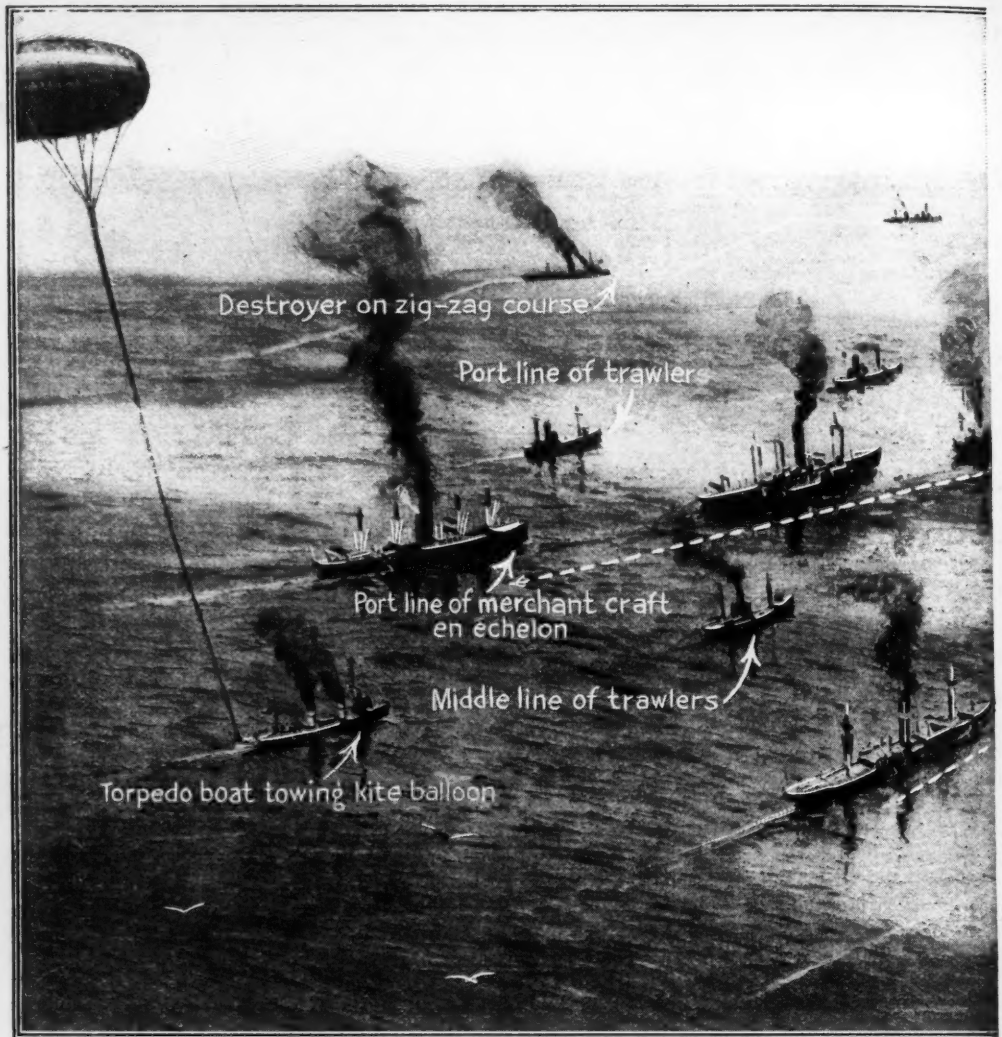
To meet this critical situation, to combat this lurking and elusive monster of the deep which played havoc with the shipping of enemies and neutrals alike, something, some method, had to be devised. It is not surprising that under the stimulus of urgent necessity the inventors of the Entente nations concentrated their efforts upon this vital subject and fairly overwhelmed their governments with an avalanche of ideas and suggestions for protecting ships against submarine attacks and for conducting war against the U-boats.

A few of these suggestions were clever and so promising of success that the naval authorities of the Entente countries gave them a trial. But, after many months of experimenting it was found that the only effective method of protecting transports and supply ships on their way through the danger zone consisted in convoying them by swift and mobile warships. One of the pictures which accompany this article gives an excellent illustration of this method in its most up-to-date development.

How the Procession Steams Along

The convoy is led by a torpedo-boat destroyer acting as a scout. It is followed by a light cruiser, which serves as flagship. Next comes a torpedo boat towing a kite balloon. Then follow the transports or merchantmen of the convoy in echelon formation, that is, each ship steams in the wake of its leader. There are two of these lines or echelons of merchantmen, separated by an echelon of trawlers and protected on the outer side by similar echelons of trawlers. Destroyers, steaming in a zig-zag course, form the flank of the convoy. The rear

Undersea Wolves Are Lurking for the Attack,


Destroyer on zig-zag course
Port line of trawlers
Port line of merchant craft en échelon
Middle line of trawlers
Torpedo boat towing kite balloon

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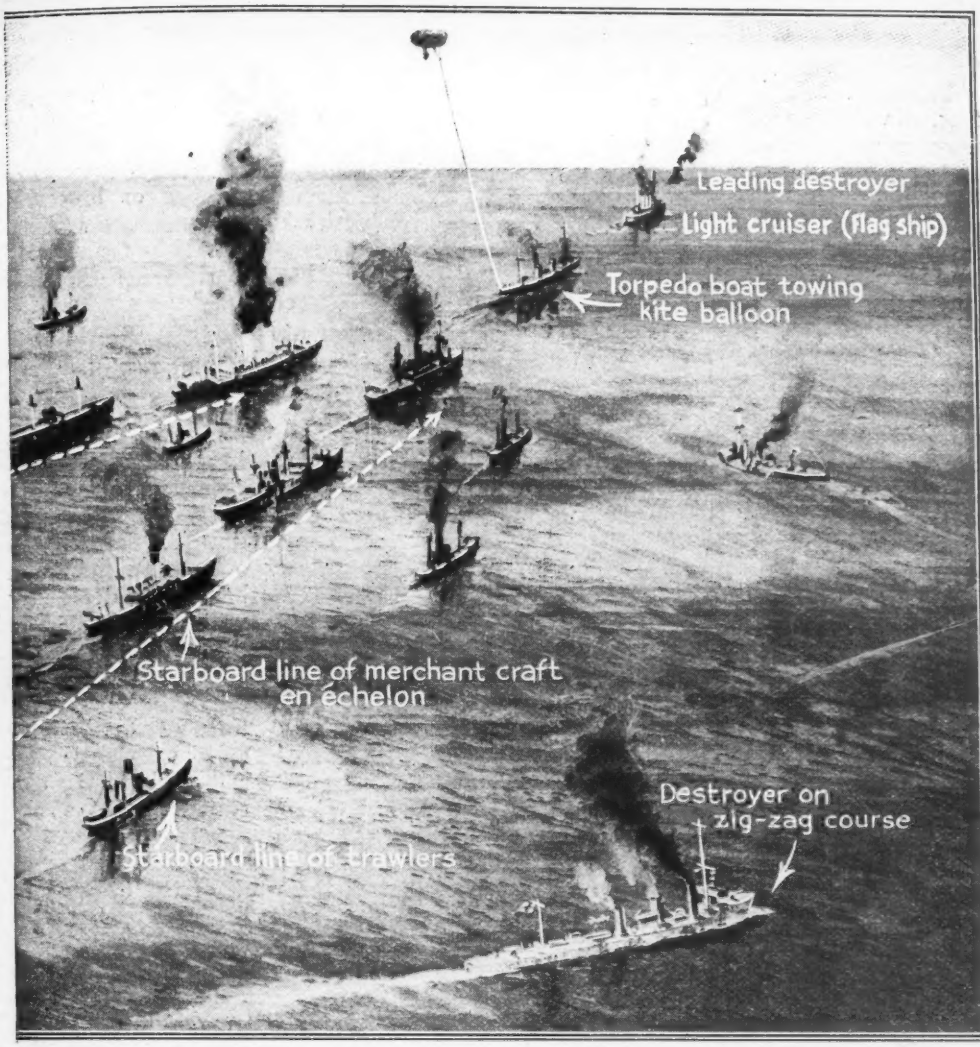
New problems in convoying merchant ships were presented by the submarine; not only is it necessary to protect the flanks of the line and keep guard ahead and astern, but the ships must steam in such order in relation to their protectors

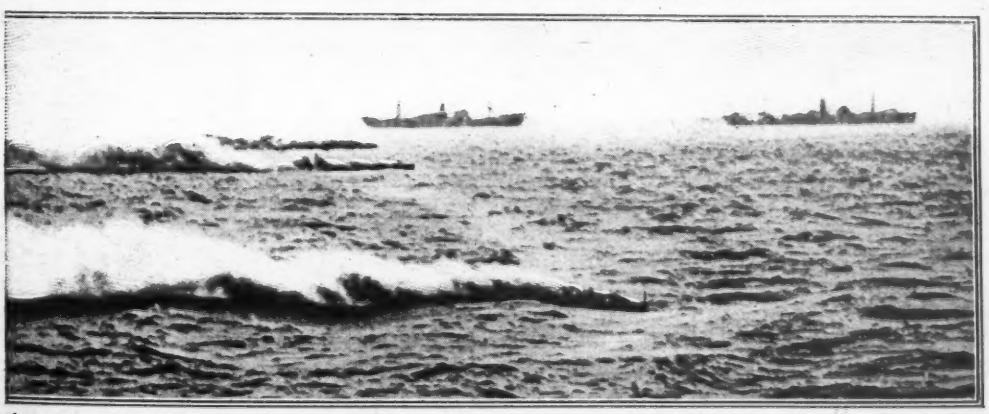
© Underwood and Underwood

Smoke-screens have been found highly efficacious as a protective measure against submarines. The point of observation of the submarine is necessarily low, so

But the Dogs of War Are Ready for Them


Leading destroyer
Light cruiser (flag ship)
Torpedo boat towing kite balloon
Starboard line of merchant craft en échelon
Destroyer on zig-zag course
Starboard line of trawlers

that it will be impossible for a U-boat to use one of the merchantmen as a shield while it attacks. It would be difficult for a submarine to break through this screen of trawlers without being caught and sent to Davy Jones's locker



that even a low bank of smoke or fog shuts off the view from the submarine. Unfortunately the screen cannot be used when the wind blows in a contrary direction

guard of the convoy consists of another torpedo boat towing a kite balloon.

These kite balloons are, as a matter of fact, one of the most important if not the most important feature of the convoy system. They are the far-seeing eyes of the sea caravan. From the deck of a ship it is extremely difficult to detect the presence of a submarine submerged so that only the periscope is above the surface. But from a balloon, towed at a height of five hundred to fifteen hundred feet, it is possible, not only to survey a much larger area, but to see submarines which are submerged or resting upon the bottom of the sea at a depth of fifty or sixty feet.

High up in the air, towed by a ship, they watch for submarines

Captive balloons were first used during our Civil War. In modern times the Japanese employed them with good effect in the siege of Port Arthur. The kite balloons used nowadays are of an approximately cylindrical form, rigged much like an ordinary kite. The harness, to which the towing cable is attached, is so arranged that the balloon cylinder always maintains an inclined position in the teeth of the wind. Suspended from the balloon is a basket which usually contains one or two observers and the necessary instruments, maps, etc. The observer is in telephonic connection with the ship towing him, and the observations reported by him are communicated to the flagship and the rest of the convoy. To keep the balloon well in the wind and to steady it, a tail of five or six small parachutes is attached to the lower end of the balloon. These balloons may be used in a moderate breeze, but cannot safely be "flown" in a wind of more than forty miles an hour. Only under the most favorable conditions can these balloons be towed at a height of 1,500 feet or more.

From his place in the basket, perhaps a thousand feet above the ocean, the observer commands a most wonderful view of the watery expanse. As far as the eye can reach the restless, ever changing ocean spreads out far beneath him. But he is not up there to admire the view, to study the picturesque beauty of the sea in its varying moods. His eye is glued to the powerful telescope or binocular with which he scans the wide expanse around him for any sign of danger. When the air is clear and the wind not too strong his task is comparatively pleasant. But, when the wind reaches the forty-mile limit, when it comes in gusts and is accompanied, perchance, by a heavy downpour of rain, the observer's position becomes decidedly uncomfortable. The basket swings most distressingly, making the taking of observations extremely difficult and the driving rain adds to the discomfort of the observer.

The physical and mental strain connected with the work of the observer is tremendous. He realizes his responsibilities and concentrates every faculty upon the task entrusted to him. The sight of a periscope or other evidence of the presence of a hostile submarine comes to him almost like a welcome relief from the terrific tension of the incessant search. After a glance at the compass before him the observer reports by telephone the exact direction in which the submarine craft was seen and its approximate distance from the convoy. A few moments later the report is flashed to the flagship and the destroyers and the necessary orders are given.

The Slow Ships Hold Back the Fleet

The convoy system has proved to be the most efficient protective measure against German submarines evolved so far, but it also has its disadvantages. Transports and heavily loaded freighters are necessarily slow. When such slow going ships form part of the convoy, the

other, faster ships must adapt their speed to that of the slower craft, as the formation of the convoy must be maintained intact. This makes the progress of a convoy often extremely slow. When the system was first introduced fast ships, weary of the slow progress of the convoy, would break out of the line at the first opportunity and perhaps fall a prey to a prowling submarine. Since then skippers have become cautious. They have learned their lesson.

Unnecessarily to retard the progress of a ship capable of making greater speed is a waste of shipping facilities the Allies can ill afford at the present time. It would be a good plan to form convoys, whenever possible, of ships of approximately the same speed.

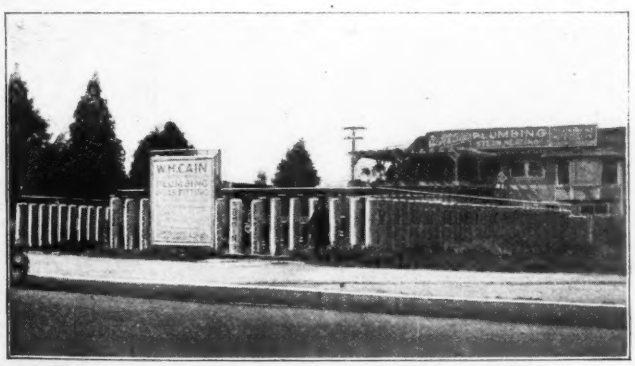
More recently the convoy system has been made safer by the addition of the smoke screen.

The skeleton of the windmill has a dress that Eve might have envied

Fenced In by Steam Boilers, He Has Reserve Stock and an Advertisement

IF you ever happen to walk down a certain street in Los Angeles, don't question the veracity of your eyesight when the craziest fence imaginable looms out before your astonished gaze. It looks as though a plumber had built a fence while in a nightmare. As a matter of fact, it does advertise a plumbing business, and it consists of galvanized iron boilers and gas hot-water heaters placed alternately and connected by regular pipe connections.

When the owner constructed this odd fence his competitors said that he must be crazy. However, he has had an excellent advertisement, and now, since plumbing fixtures are difficult to get and very costly, he is able to execute orders by drawing on this reserve stock, and is enjoying the last laugh at his rivals' lack of foresight.



This fence, made of galvanized iron boilers, advertises a plumbing business and forms a reserve stock

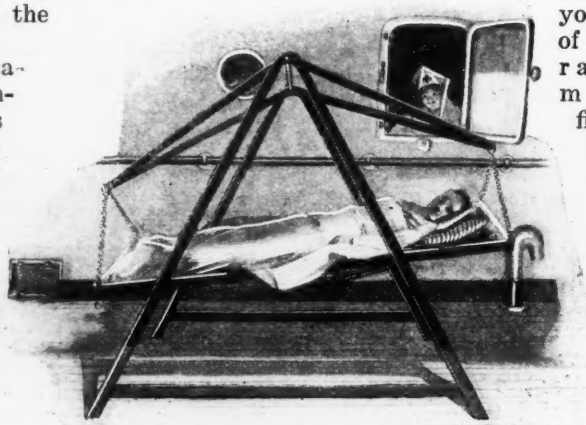
Hiding the Nakedness of a Windmill

THE highly decorative effect of ivy growing against the walls of castles and other buildings was discovered some centuries ago, but it remained for a very modern farmer to turn the climbing habit of the wild grape to good account. The photograph tells the story. The windmill was quickly turned from a bare framework, suggesting in its ugliness the inartistic but highly useful framework of a skyscraper, to a bower of beauty. As a matter of fact, the farmer used both the wild grape and the ivy (not the kind that poisons), and in two years had the framework well covered. And, as the owner said: "It didn't cost much." Moreover, the vine-clad windmill is a thing of beauty if not a joy forever.

Keeping Him Quiet While the Ship Rocks

THE usual ship's hammock is of course out of the question for a man with a leg or arm in a splint, for instance, and the berths are equally useless on account of the lurching of the vessel.

The transportation of badly wounded soldiers presents a many-sided problem which experts are finding difficult of solution in spite of the many new inventions made for the purpose. The accompanying illustration shows a hammock-bed which has been found useful on shipboard.



Let the ship pitch and roll, the hammock will always be on an even keel and the wounded man is kept quiet

In most cases it is absolutely necessary that a wounded soldier be protected from jolts. He must lie flat. On shipboard that is difficult. Hence the hammock-bed. Its construction is simple. This webbing of the hammock portion is stretched out and held taut by a wooden frame. This is suspended by chains from a frame rocking on a transverse bar connecting the side supports, as shown in the illustration.

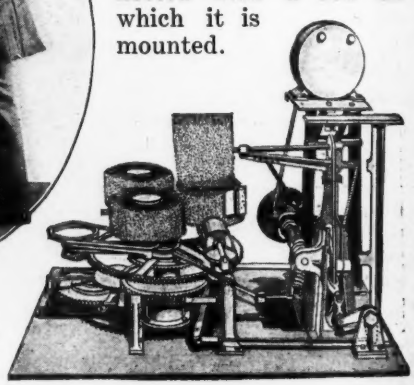
The patient is strapped to the cot so that when the vessel rocks it cannot disturb or dislodge him. The entire hammock-bed sways with the motion of the ship. The only objection which has been found to this type of bed is the sea-sickness which results from the swaying motion. This is nothing, considering the advantages of the hammock bed.

"Shine Your Shoes!" All You Do Is to Drop Dime in Slot

STEP up to the new coin-controlled boot blacking machine, ladies and gentlemen. Thrust your foot into the open mouth of the machine and steady yourself with one of the brass hand-rails. In one minute and fifteen seconds you remove your foot and gaze in admiration at your shoe. Then you thrust in the other foot and withdraw after the same interval.

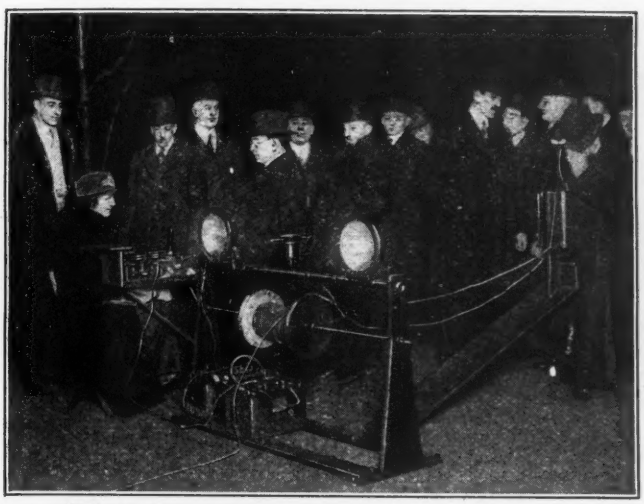
First a revolving horizontal brush that follows a track around the foot rubs off the dust. On its second revolution it applies polish three times at set intervals. The work of polishing is completed by a second horizontal revolving brush. Then another brush, with its axis at right angles to the two horizontal brushes, rocks rapidly back and forth over the toe, effectively polishing that part of the shoe. The toe brush is held down on the surface of the shoe by a light elastic pressure, due to the slightly overbalancing effect of a spring connected with a rod on which it is mounted.

Drop a coin in the slot of this machine and get your shoes polished



How Far Can a Chauffeur See a Man in Dark Clothes on a Black Night

FOLLOWING action on the part of the New York State Legislature to enact a better automobile headlight law, tests to determine how much light is necessary to reveal a man in dark clothes at distances of 150 feet and 250 feet in front of a car, and how much light the driver can tolerate in his eyes at a distance of 100 feet, were held in New York city. The conclusions were reached with the aid of a photometric apparatus so that the results could be recorded in candle-power.



This is the apparatus used to find out how far a man in dark clothes can be seen on a road at night

Two pairs of parabolic headlamps were mounted on stands and supplied with current from a storage battery. Forty-nine observers took part in the tests. Each one moved a handle and sent more or less current to the lamps, thus adjusting the amount of light to a point where he considered that he could see the person in dark clothes distinctly enough for safety in driving.

As might have been expected the results showed a wide variation in what was considered desirable intensity. The candle-power received by different observers to see a person in dark clothes 150 feet ahead of the automobile ranged from 1,000 to 10,000. The average of the observations was 3,200.

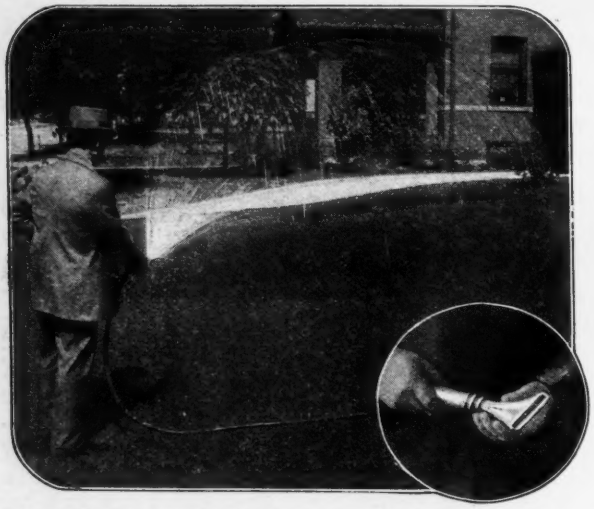
A Twenty-Five Million Dollar Ordnance Base in France

FOR use by the American expeditionary forces in France there is at present under construction a huge ordnance base which will cost twenty-five million dollars. It will include many storehouses, shop buildings, magazines, and a large store of machine tool equipment. Repair plants on a large scale for guns, carriages, small arms and machine guns, horse and infantry equipment are provided for; also reloading plant for artillery cartridge cases, carpenter shops, and other auxiliary buildings. A force of 450 officers and 16,000 men is needed to maintain the base, and about half of this force has been obtained through a special recruiting campaign instituted by the Ordnance Base Bureau.

Try this device for weeding in your little war garden

Weed the Garden With This New Tool

DANDELIONS, thistles and other kinds of weeds may be rooted out without disturbing the soil by means of a weeder provided with a three-inch digging blade that penetrates the soil like a knife. The implement pulls out the top, root and all. The blade is made of steel. A wooden handle attached to the device prevents cramping of the hand and fingers.



The narrowed outlet causes a fan-shaped stream of water to be ejected at high pressure and speed

Crush the End of a Pipe and You Produce a Perfect Garden Nozzle

THE garden sprinkling nozzle developed by Charles H. Stephan, of Springfield, Ohio, looks as if it were a piece of plain piping, struck with a hammer at its end. Though this is not exactly the way it is made, it is shaped nearly as quickly by a single blow in a forming press.

Two purposes are accomplished by flattening the end of the nozzle. First, the water is crowded through a restricted area so that it is ejected at great speed and pressure. Then, the flared end of the nozzle spreads the water into the shape of a fan. These two effects added together cause the water to spread over the largest possible amount of lawn.

Before the water leaves the nozzle, moreover, it will strike against an upright ridge. The stream of water is made to scatter further, since its impact against the ridge forms a delta-shaped spray.

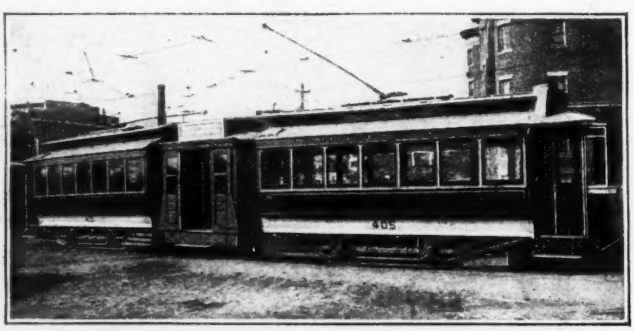
European Cattle Must Eat Leaves and Wood-Pulp

IN several European countries, notably Sweden and Germany, the scarcity of cattle-fodder has led to experiments with various substitutes for the usual feed given to cattle. It has been found that dried wood-pulp provides a good cattle-fodder when mixed with molasses and albuminous substances. In Germany straw fodder is being manufactured on a large scale; while in Sweden reindeer moss and Iceland moss are extensively used as fodder. Horses are said to thrive very well on a diet of rushes.

Bostonians Ride in "Snake" Cars That Wriggle Around Sharp Corners

SOME Boston streets have such sharp corners that short cars must be employed. But you can't pack many people in small cars. So some bright Boston mind hit on the idea of combining two short cars by means of a vestibule between. The vestibule is almost square and is actually hung from the ends of the two cars by hinged pins so that very sharp curves can be rounded with safety. In the vestibule, which serves both as entrance and as exit, stands the conductor with his fare-box. Bostonians have named this contrivance "snake car," "vertebrated car," and "two-room-and-kitchenette" car.

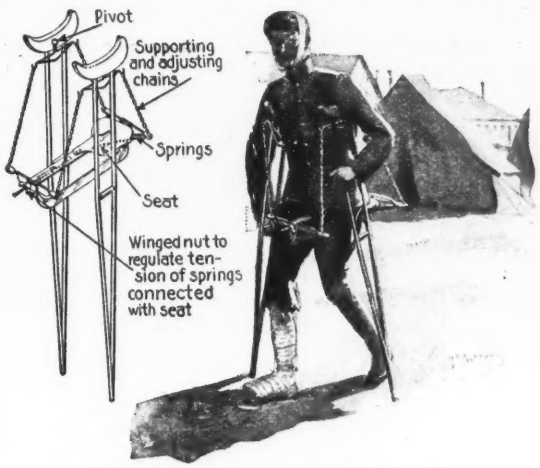
The use of these cars is really a conservation measure, since old cars have been thus saved from the junk heap. In the picture two twenty-six passenger cars are joined to the "kitchenette." These are an old type with only four wheels to a car.



Some bright Boston mind hit on the idea of combining two short cars with a vestibule to form the "snake car"

Now the Crippled Soldier Can Do His Walking Sitting Down

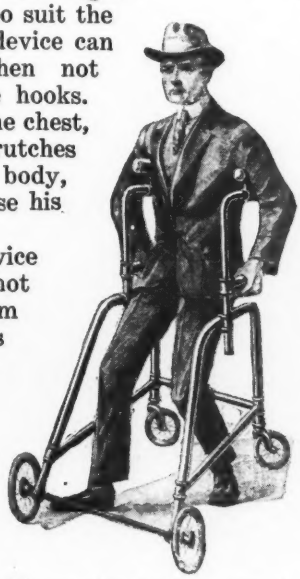
WOUNDED soldiers and ordinary invalids who are compelled to use crutches for long periods often suffer from "crutch paralysis," caused by the great strain and the pressure of the arm rests of the crutches upon the nerves of the arm pits. Two ways to avoid this have been devised recently, in both of which the invalid is enabled to sit down while he walks.



He sits in a swing as he hikes on his crutches and so dodges arm-strain

One of these boons to the crippled—shown near the top of this page—provides a swinging seat suspended between the crutches by chains or straps attached to the lower side of the arm-supports. It is the invention of Walter Clifford, of London. The seat may be shaped like a bicycle saddle, or may consist merely of pads resting upon springs. The height of the seat can be adjusted to suit the user and the entire seating device can be removed altogether when not needed by taking it off the hooks. By means of straps around the chest, or over the shoulders, the crutches may be secured to the body, leaving the invalid free to use his arms and hands.

The other ingenious device goes even further in that it not only relieves the arms from crutch strain, but enables the user to exercise his legs as much or as little as he chooses. It is especially designed for those who do not have perfect control of their legs. The weight of the body rests either on a padded spring seat or on the shoulder supports, and both are adjustable.



He can give his legs as much or as little work as he likes

The Various Ranges of Electric Searchlights on the Sea

RANGES of electrical searchlights vary, from between one thousand to two thousand yards in foggy weather to ten thousand yards or more when the air is very clear. The average range is approximately six thousand yards, but there are cases on record where ships have been spotted at a distance of nine miles. These figures are based on a sixty-inch mirror and a twenty-thousand-watt arc and are accurate.

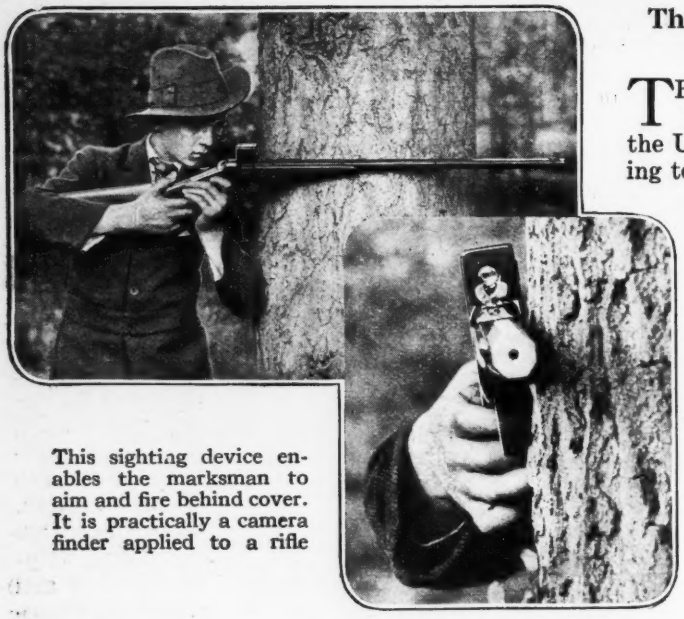
What Sounds Can Aviators Hear at Different Altitudes?

THE famous French astronomer, Camille Flammarion, gives in one of his reports the heights at which certain sounds from the earth are heard from balloons.

At an altitude of 3,000 feet the croaking of frogs was distinctly heard. At the height of 3,225 feet the rolling of a cart was made out.

At 4,550 feet the roll of a drum and the music of an orchestra were distinguished; at 5,000 feet the sound of a church bell, the crowing of a cock and sometimes the shouts of men and women. Going 900 feet higher still he heard the report of a musket and the barking and yelping of dogs.

The rumble of a railway train rose to a height of 8,200 feet and the whistle of a locomotive engine to nearly 10,000 feet.



This sighting device enables the marksman to aim and fire behind cover. It is practically a camera finder applied to a rifle

Using the Camera Finder as a Rifle Periscope

A SIDEWAYS periscope invented by Colonel Kauchich of the Austrian Army permits a sniper to hide behind a tree and fire without exposing more than his elbow. The invention operates on the same principle as the finder of a camera.

Mirrors are placed at angles of forty-five degrees near openings at each end and on opposite sides of a square tube attached to the barrel of the rifle just beyond the hammer. The reflection of the target is caught in one mirror, and this in turn is reflected through the tube to the other, set directly over the barrel, enabling the marksman to aim correctly without danger to himself.

The Non-Ricochet Shell Is a New Terror

THE non-ricochet shell has been used with success by the United States Navy, according to a public statement made by Chairman Oliver of the House committee investigating the conduct of the Navy.

In the past, there have been designed projectiles that will dive, but it was difficult to construct a fuse that will not cause an explosion upon contact with the water. The new shell is a flat-nosed contrivance which, on striking the water, continues its downward course at a slightly lower angle until it reaches its objective. It may be fired to strike the water on the near side of the target, a periscope, for instance, and submerge until it reaches its objective, a submarine, for example. An ordinary projectile, failing to hit the target but striking the water, will sometimes leap into the air and pass over its objective.

Armoring the Infantryman's Knuckles with Steel Bullet Deflectors

IT occurred to C. H. Gavin, of Natick, Mass., that every part of a soldier's anatomy was better protected than his hands, which are really his most valuable tools. So he invented a protector in the form of a piece of steel bent to fit the back of the hand and held in place by a steel strip passing across the palm.

This hand armor does not interfere with the action of the hand in any way. A soldier can dress, shave, eat, and handle his rifle without the least handicap.

"Lucky I had my steel knuckles on in that raid," says Files on brigade. "What if it had hit my bare hand!"

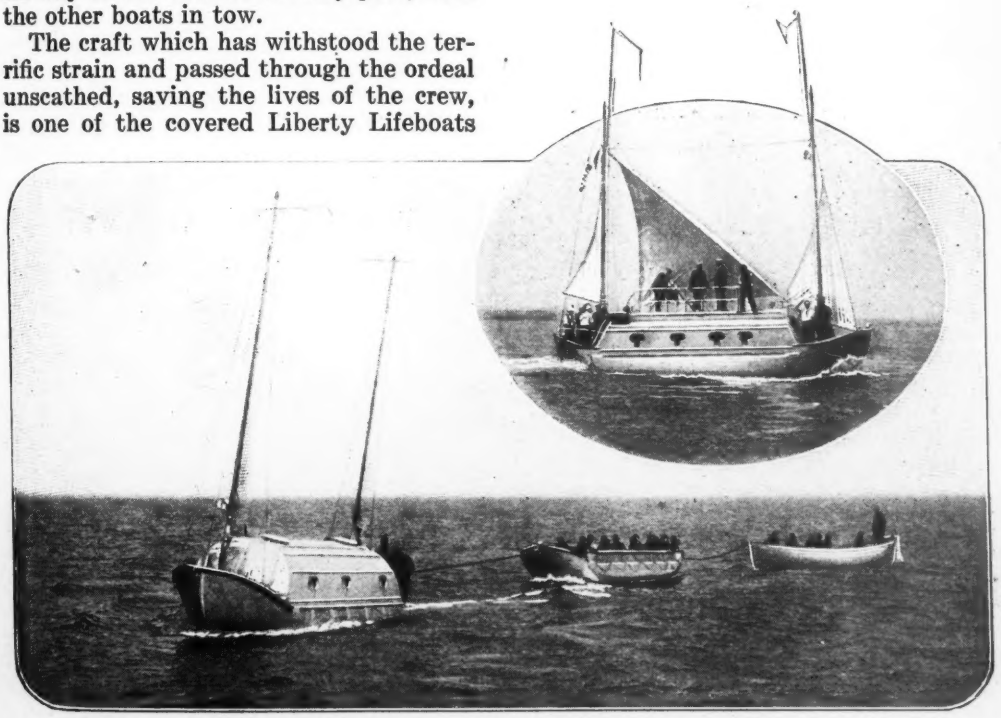
She Always Rights Herself

Stanch, buoyant and equipped with a powerful gasoline engine, the Liberty Lifeboat is designed to weather all storms

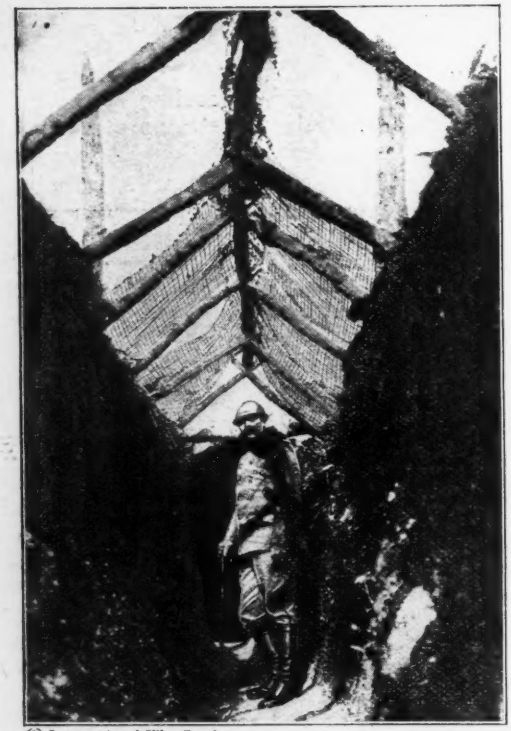
"ALL hands on deck!" The captain's stern command rings out clarion-like through all parts of the big freighter, which lists heavily to port since the explosion of the torpedo a few minutes ago. Nevertheless, the crew manages to lower several lifeboats, big and little.

Now the big ship lurches and sinks beneath the waves. The starboard lifeboat with its load of men is nearly drawn into the vortex and the men work desperately at the oars to keep afloat. Only a short distance from the small boat the big power lifeboat is seen, slowly rocking and turning in the widening whirlpool caused by the sinking of the ship. It has withstood the tremendous pressure of the water. Quickly righting itself it has bobbed to the surface like a cork. Ten minutes later the big lifeboat, under the power of its gasoline engine, starts on its way to the nearest friendly port, with the other boats in tow.

The craft which has withstood the terrific strain and passed through the ordeal unscathed, saving the lives of the crew, is one of the covered Liberty Lifeboats invented by Captain A. P. Lundin. These boats, thirty feet in length and about ten feet beam, are built of steel and protected by thick fenders of balsa wood. So great is their buoyancy that even if capsized by some accident, the boats will right themselves in a few seconds. The most important feature is a powerful gasoline engine of twenty-four horsepower, capable of propelling the boat at a speed of six to seven miles an hour. The fuel capacity is about one hundred and fifty gallons, enough to carry the boat about three hundred miles. The total weight of such a boat, including its permanent equipment, is about 9000 pounds. Masts and sails or even a radio equipment may be carried by these boats which, being extremely buoyant and completely covered, afford protection from the heaving sea and the inclemency of the weather.



A Liberty Lifeboat, equipped with engine and wireless, is shown here towing two open lifeboats. Above, it is shown with sails as an auxiliary to its gasoline engine



© International Film Service

Above his head is a wire netting which deflects the fragments of bursting grenades and bombs

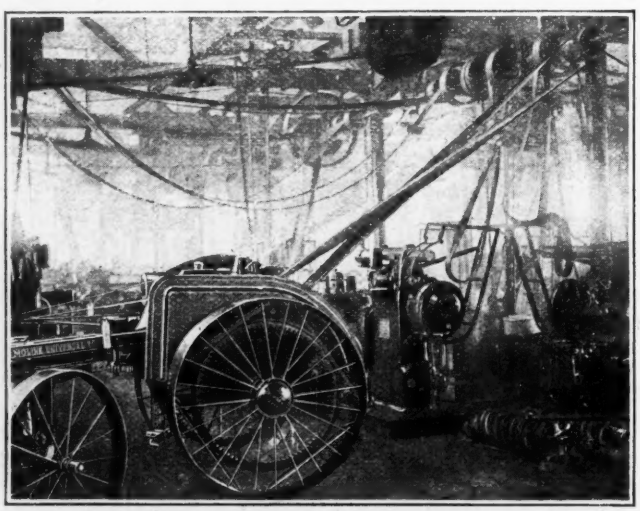
Protect Your Trench with a Deflector Made of Wire Netting

THE trench mortar fires its missiles so that they fall almost vertically into the opposite trench; the hand grenade follows a similar course. Shrapnel is timed to explode so that its bullets spray the ground below like rain. Now you understand why a trench cover is employed on the Western front, consisting of a sloping wooden framework on which is stretched a screen of wire netting. The object is to deflect the grenades and small shells which would otherwise explode in the trench. By deflecting the fragments of exploding missiles the screen acts as a shelter.

Making Tractors by Using Tractor Power

A SHORT time ago the transformer through which the electricity passes for supplying the power for a large tractor plant in Illinois was overloaded and consequently burned out. Every wheel came to a standstill—a serious matter for the factory which had been running at top speed to fill orders. In this emergency it occurred to the superintendent to use a number of tractors in stock to supply the necessary power to manufacture more tractors. The machinery of the tractors was connected by belts with the pulleys driving the various shapers, drilling and milling machines. In a few hours the plant was humming again.

The controllable governor of the traction engines made it possible to adjust the speed of the engine to that required for the machinery, which varies between six hundred and fourteen hundred revolutions an hour. The tractor engines stood the test well, although some of them were run at overcapacity for forty-eight hours without slowing down. Then the fuel tanks were refilled and they were started again and run for seventy-two hours without stopping. The picture on the left shows one of the tractors at work.

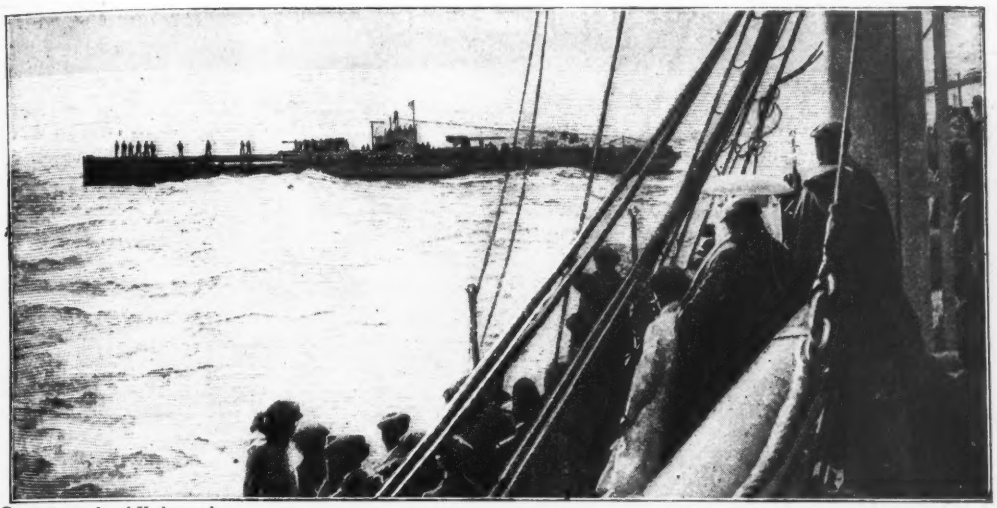


The versatile superintendent of a tractor plant in Illinois made the tractors reproduce their kind

Terrorizing Our Atlantic Seaboard

Depth-bombs, nets, mines, destroyers, and seaplanes have not exterminated the pest of the seas nor kept it at home. How can America protect herself?

By Simon Lake



© Underwood and Underwood

The German terror of the sea has become more terrible. The latest cruiser type, here pictured, the type that probably sank ships off our coast, is about 250 feet long and is armed with two 5.9 inch guns. She can fight armed merchantmen, old destroyers, and the average patrol

Mr. Lake needs no introduction to our readers. He is one of the pioneer inventors who gave us the practical submarine. He has been employed at various times by the governments of the world to design or build submarines, and it was he who taught the Krupps how to build U-boats.—THE EDITOR.

ALTHOUGH the U-53 voyaged across the Atlantic, slipped in and out of Newport and then sank half a dozen ships off Nantucket at a time when we were still neutral, although the *Deutschland* made two highly successful and profitable visits to these shores, the recent attacks of submarines on ships off the Atlantic coast amazed us with their dramatic suddenness. But, then, surprise is the very essence of the U-boat's methods. A full week elapsed before the Government was aware of the first sinking. The American public naturally asks itself: What can be done to stop the Germans?

Dernburg, of unsavory memory, recently announced that the average cargo is worth $175 a ton and that it costs $250 to supply each new ton of shipping. At this rate, estimates the English naval critic, Arthur Pollen, the submarine war has already cost the anti-German world over $6,150,000,000. In four years about 22,000,000 tons of shipping have been lost.

In the third year of the war, by which time it might be concluded that the various methods devised for coping with the submarine would have been made truly effective, about three million tons were sent to the bottom.

And what is the remedy proposed to offset this continuing loss? To build ships faster than the U-boats can sink them. To me nothing is more ridiculous. Even admitting that all the tonnage required can be produced in the way of surface ships, it must also be admitted that to do so entails the employment of thousands of workmen and thousands of tons of material required for other purposes. A crumb of comfort is found in the fact that the sinkings are not quite so numerous as they were two years ago. There are fewer ships to sink. Besides, captains are more cautious than they were, and nets and patrols count for some-

thing, however little. It remains to be seen if there will not be a marked increase in the sinkings as soon as the new ships that we are building are commissioned.

Submarines Are Not Easily Sunk

How many submarines have been sunk since September, 1914? No one knows. But despite everything, the most optimistic compiler of statistics would not place the number at more than one hundred. Commander Taussig of our navy recently said that "a submarine is a very difficult bird to catch." He had himself engaged only one U-boat in seven months and was not sure that he had sunk any.

© International Film

Saved with all her nine lives

Submerged, a submarine must keep moving or else must rest on the bottom; and this last is impossible except in depths which are less than two hundred feet. Now the Atlantic seaboard is literally made for concealing submarines. Taken as a whole, it is a long stretch of sand which slopes out into the ocean very gently. Within a hundred miles off the coast the submarine can find a resting place that is ideal.

Those who place their reliance on seaplanes and dirigibles to detect a submerged submarine know little of the difficulties that confront the observer in the air. It is only in still, clear water that a U-boat can be seen beneath the surface. In even moderately rough water nothing is visible; and the water is usually more than moderately rough. Moreover, let it not be forgotten that many long hours elapsed before one of the lifeboats cruelly set adrift by the Germans after sinking a ship off our coast was picked up; no seaplane had helped in her recovery.

A U-Boat Needs No American Base

We read much nonsense about mysterious U-boat bases on the Atlantic coast. No land base is necessary. A German submarine of the latest cruiser-type is of about two thousand tons displacement and is about two hundred and fifty feet long. Her carrying capacity is easily six hundred tons. Suppose that four hundred tons of fuel-oil are taken on board, one hundred tons of shells, bombs and torpedoes, and one hundred tons of food. With such a supply of stores she could prowl in our waters for many weeks, and even for months. She would husband her fuel, jogging along at about ten knots, as a rule, and attaining a maximum of fourteen only when she is bent on overhauling a fleeing ship. If a base were necessary an out-and-out submarine cargo-carrier of the *Deutschland* type would answer all purposes.

There is but one remedy, in my opinion, and that is to pit submarine against submarine. Build submersible cargo-carriers, like the *Deutschland*, and the Allies may snap their fingers at the U-boat. I have advocated the plan in the POPULAR SCIENCE MONTHLY, and in other publications. It is unnecessary to repeat the details. Since I wrote for the POPULAR SCIENCE MONTHLY I have studied the subject further. I have even designed a submarine cargo-carrier according to the specifi-

© International Film

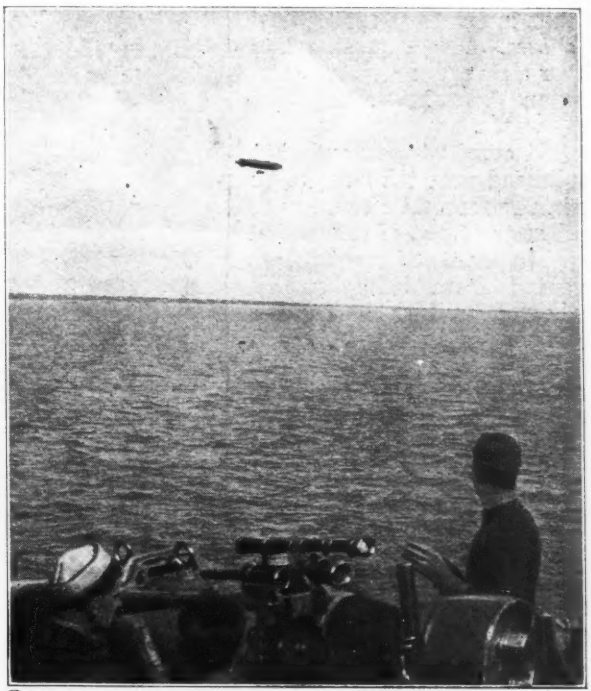
They were on the "Texel", torpedoed and beached off New Jersey

cations of Lloyd's—specifications which are followed the world over in building surface ships. To my astonishment the resulting vessel proves to be far stronger than I had imagined. It would actually be able to withstand submergence to a depth of eight hundred feet without collapsing. No submarine of the present day could descend so far in safety.

The Armored Submarine of the Future

Now that its radius of action has been so tremendously increased the submarine problem becomes more difficult of solution. The mid-Atlantic becomes as dangerous as the waters surrounding Great Britain.

The new German diving cruisers carry 5.9 in. guns and can fight. We read almost every day of engagements between armed merchantmen and U-boats. In other words, the submarine does not even have to submerge in order to escape. Safety is now sought beneath the waves only in desperate situations. As for the many patrol vessels that swarm in European and American waters, most of them are too slow and too lightly armed to be of any real value. Thus, it is said that the Ford submarine chasers are to be armed with only four-inch guns.



© International News

Far, far out at sea the navy's dirigibles ("blimps" of the English model) hunted for U-boats and for survivors in life boats

What Von Tirpitz Wanted

We have here some indication of what the future holds forth. U-boats will unquestionably be armored; they will carry heavier guns; they will be larger; they will be faster.

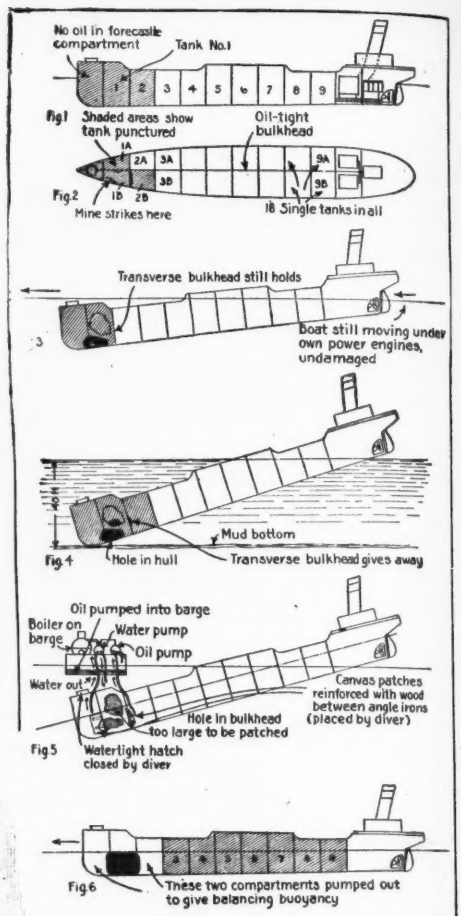
If I know anything of the German mind and of German technical boldness—and I may lay claim to some such knowledge in view of my past relations with the German navy and with the Krupp works—the Germans are not unlikely to produce an armored submersible during the present war, if it lasts much longer. About twelve years ago, at a time when I was asked by the Krupps to rectify some errors that had been made by them in building submarines for the Russian government, I met the redoubtable Admiral von Tirpitz. I showed him the plans for two submarines — one a defensive type, the other an offensive type. The offensive type had an armored gun turret such as I am now advocating. When von Tirpitz saw the blueprints of the offensive type, he brushed aside the plans of the other and said: "This is what we want."

At that time the Navy Department of the United States was taking a rather lukewarm interest in submarines and had not made up its mind in what particular niche the submarine fitted. But von Tirpitz, father of the German navy, von Tirpitz, the advocate of ruthless submarine warfare, saw the possibilities at once and displayed interest in a type about which our own officers are still skeptical. It is not likely that he has forgotten his desire for a craft which would be a kind of submersible battleship and which would be able to take its place lined up with dreadnoughts.

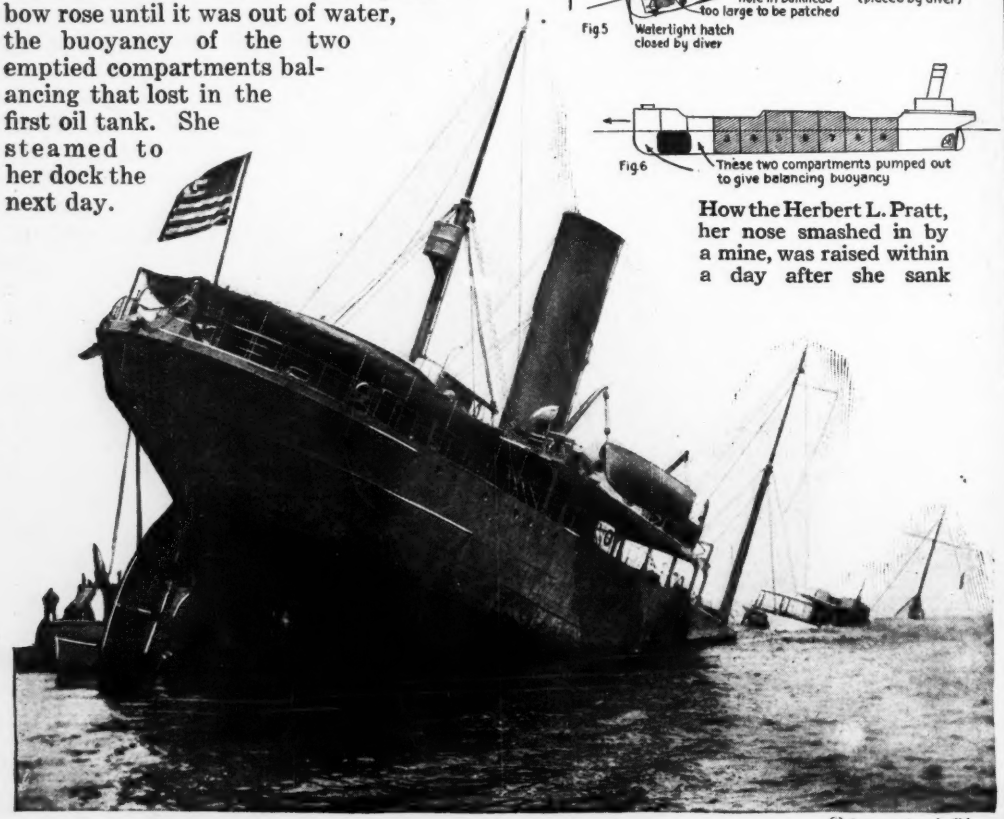
Mined! But She Limped Back to Port

THE oil tanker, *Herbert L. Pratt*, struck a mine on June 2 off the Delaware Capes. It was in all probability a mine "laid" by one of the German submarines that spread terror along our shores. The explosion had punctured four of her eighteen compartments. The uninjured sections kept her afloat, but with her nose in the water.

The hole in the first compartment and that in the centerline bulkhead were too large to be patched, but that in the forecastle and in the transverse bulkhead at the front of the second oil tank were plugged by means of canvas mats which were prevented from being sucked through the holes they covered by short pieces of timbers set in between the twisted bulkhead stiffener angle irons. The watertight deck hatch in the forecastle deck was closed and the pumps started to work. With free water in the first oil tank compartment, the forecastle and second oil tank compartments were pumped and between 8,000 and 10,000 barrels of oil and water removed. Slowly the bow rose until it was out of water, the buoyancy of the two emptied compartments balancing that lost in the first oil tank. She steamed to her dock the next day.


No oil in forecastle compartment
Tank No.1
1 2 3 4 5 6 7 8 9
Fig.1 Shaded areas show tank punctured
Oil-tight bulkhead
1A 2A 3A 3A
1B 2B 3B 3B
Fig.2 Mine strikes here
18 Single tanks in all
Transverse bulkhead still holds
Boat still moving under own power engines, undamaged
Mud bottom
Fig.4 Hole in hull
Transverse bulkhead gives away
Oil pumped into barge
Boiler on barge
Water pump
Oil pump
Water out
Canvas patches reinforced with wood between angle irons (placed by diver)
Hole in bulkhead too large to be patched
Fig.5 Watertight hatch closed by diver
Fig.6
These two compartments pumped out to give balancing buoyancy

How the Herbert L. Pratt, her nose smashed in by a mine, was raised within a day after she sank



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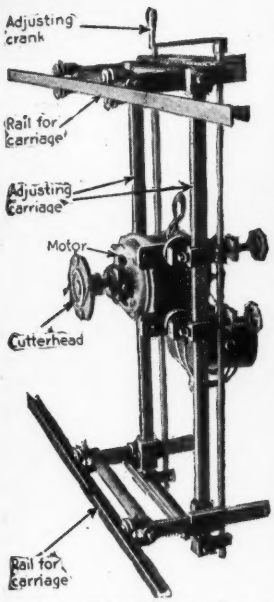
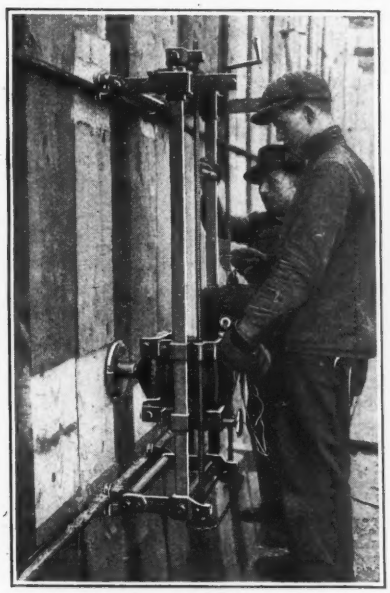




The disk-like rotating cut-head does the work hitherto done by the adz. It can be moved in two directions at right angles to each other. The machine runs on rails which can be bent in a working day of eight hours. The cost of operating the machine is about $10 a day, counting wages.

The cutting is done by a disk-like rotating head mounted on the shaft of a specially constructed motor which has a speed of 3600 revolutions a minute. The motor is mounted upon two bars which are at right angles to the direction of travel in dressing the surface of the timber. These transverse bars are supported at their ends by arms provided with grooved and ball-bearing wheels. These wheels ride upon T-rails which form a track along which the machine can be moved.

In Which We Tell You What "Dubbing" Means in Shipbuilding

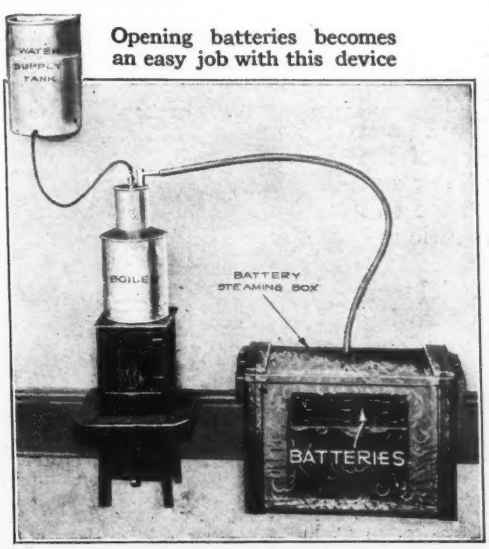
AFTER the framework of a ship in course of construction is completed, the rough timbers must be "dubbed." And that means? Simply that they must be planed snug and smooth before the planking can be put on. Heretofore the work of "dubbing" has been done by hand. Scores of adzmen were employed in every shipyard for that work. The "dubbing" had to be done with great care; otherwise the planks would not fit properly.

A ship carpenter named Clark, in Seattle, recently invented a machine for "dubbing" timber, which will do as much work as forty adze-wielders. And with greater precision. With a single machine one man and a helper can plane from 1500 to 2000 square feet

No More Trouble Getting Inside Your Storage Battery

A NEW device for softening the seals of storage batteries by steam works automatically. A steam generator, a steaming box and a water supply tank are its essential parts. The generator consists of a small cylindrical tank placed over a little gas, oil or gasoline stove. It contains a small float which operates a plunger to cloes the water-in-take valve as soon as the water reaches a point about three inches from the bottom. In this manner the amount of water in the tank is automatically controlled to remain constant so long as the outside tank is replenished and the mechanic can put a battery in the steam box and leave it without attention while the seals are being softened while he does other work.

Opening batteries becomes an easy job with this device



Speeding Mail by the Sky Post

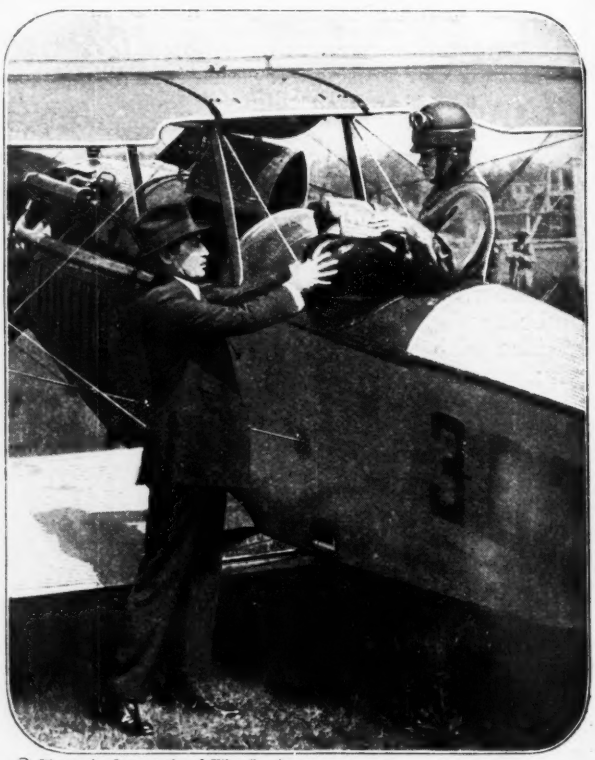
The establishment of the aerial mail service between New York and Washington an epoch-making event

When Lieutenant Boyle started on his first mail-carrying trip from Washington, President Wilson wished him the best of luck

FUTURE histories of civilization will make a record of May 15, 1918, as the day marking the beginning of a new epoch in the evolution of the mail service. On that day the service over the first regular aerial mail route, between New York and Washington, with Philadelphia as an intermediate station, was inaugurated. Since then a number of successful flights between the three cities have been made. Notwithstanding a few mishaps the service proved so reliable and efficient that the Government already considers plans for the extension of the sky post by establishing additional routes. Among the lines to be established next are routes between New York and Boston and New York and Chicago. The doubling of the service between New York and Washington, so as to have two trips daily, is also seriously considered.

The opening of the aerial mail service was made the occasion of a ceremony at both ends of the route. Government officials and prominent representatives of the State and municipal governments attended the starting of the airplanes on their initial trips. The War Department had furnished twelve large training airplanes for use in the mail service and detailed several competent flyers from the Aviation Division of the United States Signal Corps. The airplanes placed in the service are built like the army biplanes used for bombing. They are intended to carry only a pilot, so as to give more room for mail. Their carrying capacity is about 300 pounds, but later on airplanes with a capacity of 600 or 700 pounds of mail will be provided.

Lieutenant Torrey H. Webb made the first trip from Belmont Park, New York, to the Bustleton aviation field, Philadelphia, in a Curtiss machine. With 144 pounds of mail, he started at 11.30 o'clock in the forenoon and reached Philadelphia safely at half-past twelve. The mail for Washington was transferred to another airplane piloted by Lieutenant J.



© Photos by International Film Service

Postmaster Patton of New York is shown in this picture handing the mail for Washington to Lieutenant Webb

Edgerton and arrived at the Polo Grounds of Washington at 2.50 P. M.

Lieutenant George L. Boyle, who had been selected for the first mail trip from Washington, left the Polo Grounds with 150 pounds of mail at ten minutes before noon. Twenty minutes later he was forced to land at Waldorf, Md., as he had lost his way in the fog. In landing he broke one of his propeller blades, for which reason the mail was taken to Philadelphia by automobile. Without waiting for the arrival of the Washington mail, Lieutenant Howard Culver, with a bundle of 350 letters, started from the Bustleton field at 2.20 P. M. and reached Belmont Park in New York at 3.37 P. M. without mishap.

Lieutenant Webb starting from Belmont Park, New York, on the first aerial mail service trip to Philadelphia at which he arrived in one hour

On the second day of the service Lieutenant Stephen Bonsal, who had started from Belmont Park in a new airplane with seventeen pounds of mail, lost his way in the fog and was compelled to make a landing on the old Bridgeton, N. J., race track. In landing he crashed into a fence and broke the propeller and one of the planes. Again the mail was taken to its destination in an automobile. The north bound relay trip was accomplished successfully. The trip from Washington to Philadelphia with 118 pounds of mail was made by Lieutenant Edgerton. Lieutenant Webb relayed the Washington mail and with five pounds additional mail from Philadelphia reached Belmont Park at 2.58 P. M.

The airplanes used for carrying the mail are capable of a speed of 95 to 100 miles an hour, but for various reasons that speed was never even approached on any trip. Yet, from six to eight hours were gained in comparison with the regular mail service by railroad. It is the intention of the postal authorities to improve the service by using more powerful and swifter airplanes and it is confidently expected that it will be possible to continue the service all the year round. Storms in summer and blizzards in winter may interfere occasionally with the aerial mail and mishaps may not always be avoidable.

A stand that shows pictures or magazines to advantage

This Stand Will Display Your Popular Science Monthly

THE stand shown on the left, for displaying books, magazines, signs and stationery, is collapsible and well adapted to the use of retail dealers. The upright section can be adjusted so as to stand at any one of five different angles in order to get the best light or attract the prospective patron's eye. The collapsible feature of the stand enables it to be stored in a small space. It can be made of tinned or oxidized metal. More expensive ones may be silver-plated or gold-plated according to taste.

The ice mold, which is operated best in a shady place in the open air

You Need Ice Now? Get Ready for the Harvest

WHERE winters are cold and pure water can be had, any householder can keep himself supplied with wholesome ice all the year round by using a freezing mold of suitable construction and storing the ice in a cool place. A manufacturer in Spokane, Wash., has placed such a freezing mold on the market. Its construction is based upon sound scientific principles. It is so simple that even a boy can use it with success.

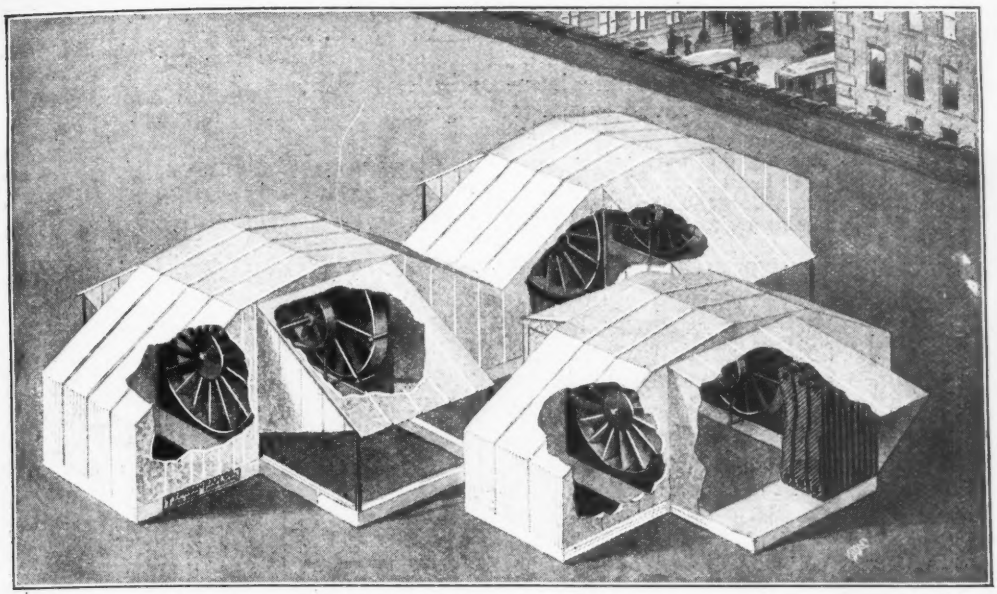
The mold consists of a galvanized iron container mounted on strap-iron rockers or shoes and equipped inside with an automatic expansion air chamber. The expansion chamber consists of a water-tight tube. The rubber walls of the chamber are made from a standard size inner tube for automobile tires. The cylindrical ends over which the rubber is drawn are separated by a pipe which passes through one end and thence to the air, down through the bottom of the mold. This pipe has a hole which permits the air to pass out of the chamber when the expanding freezing water compresses the walls. Six spiral springs, stretched from one end piece to the other prevent the tube from caving in under mere water pressure. This expansion chamber is essential, as it prevents the expanding water from bursting the shell of ice already formed.

This mold is intended to mold ice shells from ⅜ of an inch to 2 inches in thickness, not to freeze solid cakes of ice. After the shell is frozen, which takes from 2½ to 9 hours according to the outside temperature, the shell is slipped out of the mold and filled with water which is then allowed to freeze to form a solid cake. To keep the water at the bottom of the mold from freezing the bottom is made of a board, which is separated from the metal by a layer of cork or fiber felt. When the mold is turned upside down and the ice shell slipped out, the shell will be found open at the top. After it has been filled with water, the opening is closed with a cover, consisting of wire screening in a wooden frame and covered with burlap or canvas.

How a Chautauqua lecturer could moralize on the tree that seeks to burst the bounds of the wheel!

Wheel and Tree Puzzle

A FARMER rolled an old wagon wheel into a corner of the lot. It lay hidden amid weeds and débris. In the course of time a tiny tree started to grow between two of the spokes and grew so big that it broke one of the spokes from the rim and threatens to break another. The puzzle: separate wheel and tree.



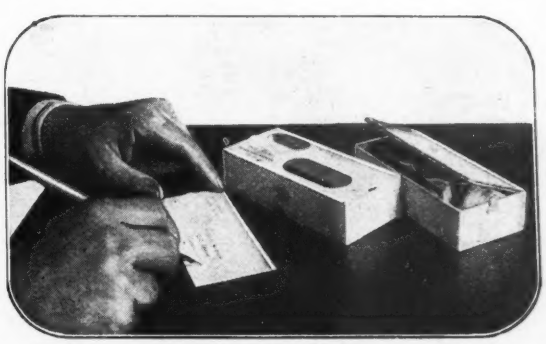
One or two of these fans suffice for the average hall, for very large halls more fans are required. They demonstrate the fact that one may be comfortable though in mid-summer

"Ten Degrees Cooler Than Outside." And It's True, Too!

ON a hot summer day even the most persuasive barker or press agent will find it difficult to convince the public that they will find it pleasant and cool in his theater. But the person who feels a pleasantly cool draft coming from the open door of the theater when he passes will be convinced and ready to go to the box-office for a ticket. One or two blowers placed on the roof of the building or in some other convenient place and so arranged that they draw comparatively dust-free air and force it through suitably provided openings into the auditorium are all that is needed to produce a circulation of air in the hottest and stuffiest hall. The cool, fresh breeze from the outside, which is pumped into the hall, displaces the hot and stagnant air contained therein and, if the precaution is taken to arrange the openings for the admission of the fresh air above the heads of the spectators, all disagreeable drafts are avoided. A New York manufacturing concern is making them.

Don't Throw Away the Box. Use It for Remailing

REMAILING by means of the same box in which an article is sent is rendered convenient by a mailing box that has a transparent opening for the address of the sender and another for the address of the receiver. Cards bearing the addresses can easily be reversed so that the box may be prepared for remailing. The words "To" and "From" are on the transparencies and not on the cards themselves. One box can, of course, be used a number of times, cards being inserted for the different addresses and removed at will.



It has two transparent openings—one for the sender's address and the other for the receiver's

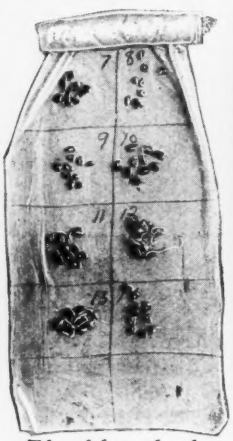
Test Seed Corn with a "Rag Doll"

A simple, homemade device recommended by Department of Agriculture to the farmer

The rag doll corn tester as it looks when all prepared for the work of testing grains of seed corn

DEFECTIVE seed corn means a loss of millions to the United States annually. Clearly some method ought to be adopted to ascertain whether or not seed corn will germinate. The Bureau of Plant Industry of the Department of Agriculture is doing its best to encourage the use of the "rag doll" tester—a device which can be made at home. Here are the directions:

Cut bleached muslin into strips sixteen inches wide and from three to five inches long. Leaving a margin of four inches at the ends, mark the strip crosswise every four inches. Number the sections.

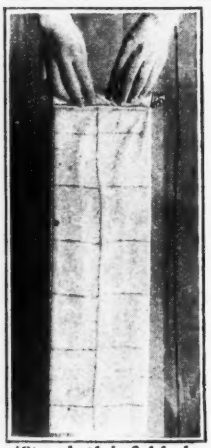


The bleached muslin is marked off in squares

Number the ears to be tested and place them in systematic order. Dampen the tester. From different places on ear 1 take out ten kernels and place them in section 1. In a similar manner, take ten kernels from ear 2, place them in section 2. Continue until every section of the tester has been filled.

Place the kernels some distance from the dividing lines, so that the samples will not be mixed in handling the tester. Fold each side of the tester over so that the edges meet in the middle, as shown in one of the illustrations. Press the cloth down securely over the kernels. Using a corncob as a core, roll the tester up. Tie a cord or slip a rubber band around the middle. The job of manufacturing the doll is complete.

Now the process of germination begins. The doll is soaked in lukewarm water from two to four hours, with ten hours as the maximum. Then it is removed from the water, permitted to drain, and placed in a warm, moist spot. During the germination period the doll should not be subjected to a temperature higher than one hundred or lower than fifty degrees Fahrenheit.



The cloth is folded once, then rolled up around a cob

Don't souse the doll a second time. To prevent its drying out, wrap it in a piece of wet sacking or stand it upright in a water bucket, covered with a wet cloth. Excess moisture should be drained off. At the end of five days the sound kernels should have sprouted sufficiently to differentiate them from faulty seed. Seed dealers and their traveling agents are offering many kinds of seed-testing apparatus but the home-manufactured device, as outlined above, has all the virtues of the commercial product, without its fancy price. The Bureau of Plant Industry of the United States Department of Agriculture has only lately checked up the merits and demerits of the rag-doll seed tester and finds it entirely satisfactory.

Wrap dolls in wet sacking or stand them upright in water bucket covered with wet cloth to avoid drying

Studying Trench Warfare with the Aid of an Intricate Model

THE art of constructing entrenchments has become a science of hitherto undreamed of possibilities. Never before was trench war conducted on such a large scale. Its development, influenced by modern improvements and changes in weapons, tactics, and conditions, has become so intricate that a special course of study, embodying the principles and endless details of trench fighting had to be devised for the officers and non-commissioned officers who are to enter service at the front. The accompanying picture shows how the non-commissioned officers in training at Camp Grant, Ill., are taught the intricacies of modern trench warfare by means of a model representing the most advanced ideas of trench construction as practised by the French engineers on the West front.

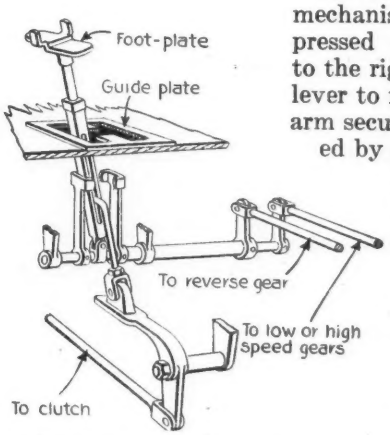
A model of a modern trench system looks like a picture puzzle; but each kink and twist has a meaning of its own

The trench-lines of the sector shown seem like a picture puzzle. Their apparently artless irregularity is not a matter of chance. It is based upon sound scientific principles, and there is a good reason for every kink and twist. The different features of trench fighting must be studied in detail.

A Foot Operates the Clutch and Gear-Shifting Mechanism

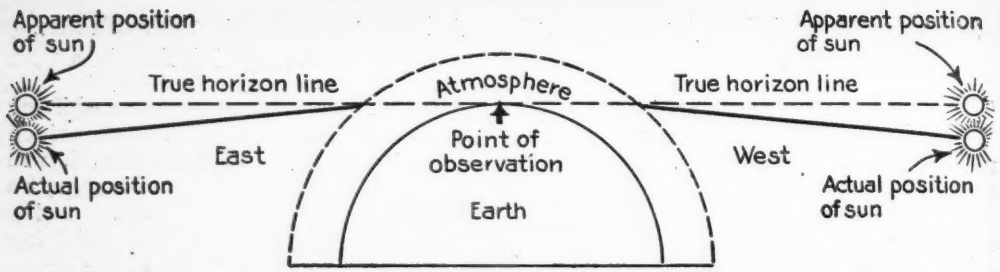
THE clutch pedal and the gear-shifting mechanism have been so combined by E. R. Martino that the clutch will always be out during the shifting of the gears.

Attached to the pedal is a rod extending through a pivoted tubular lever. Through a slot in the hollow lever runs an elbow rod which has a pivoted shoe resting on a rod controlling the clutch. When the driver presses the pedal downward with his foot the shoe moves correspondingly, operating the rod attached to the clutch and throwing it out. The pedal, after it has been relieved of the foot pressure, returns to its former position, and a spring throws the clutch in again.



The clutch will always be out while the gears are being shifted

In order to adjust the speed mechanism the pedal is depressed and moved sideways to the right, causing the hollow lever to rest in a socket on an arm secured to a shaft connected by a lever with the speed gears. Then the pedal is released, throwing in the clutch, and moved forward or backward, according to the speed desired. Reversal of the automobile is brought about by pressing down the pedal and then throwing it to the left and forward.



Because its rays are bent by the atmosphere, the sun appears to rise or to set when it is really below the horizon. A study of this diagram will make this clear to the reader

The Sun Really Rises After We See It Rise. Why?

HAS it ever occurred to you that we never see our Sun either rise or set? When it seems to rise or when it seems to set it is below the horizon.

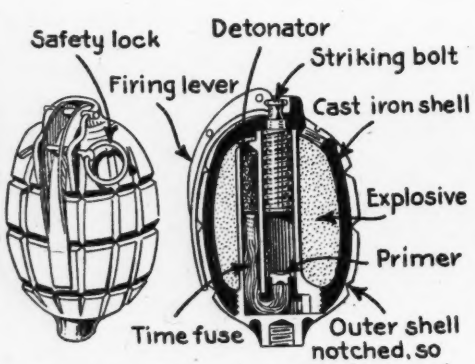
These statements are absolutely true. Our eyes do not deceive us, but the atmosphere does. It possesses a quality of refracting or changing the direction of the Sun's rays. These rays enter our Earth's atmosphere, at sunrise or sunset, obliquely, and then instead of proceeding in a straight line they are so bent out of their natural course that the Sun's rays reach us before he begins to appear above the eastern horizon and after it has wholly disappeared below the western horizon. In other words, our Sun really rises after we have seen it rise and really sets before we have seen it set.

How the Deadly Mills Hand Grenade Is Made and Exploded

THE grenades which are used by the French and allied troops at the West front are of the type invented by William Mills, an Englishman.

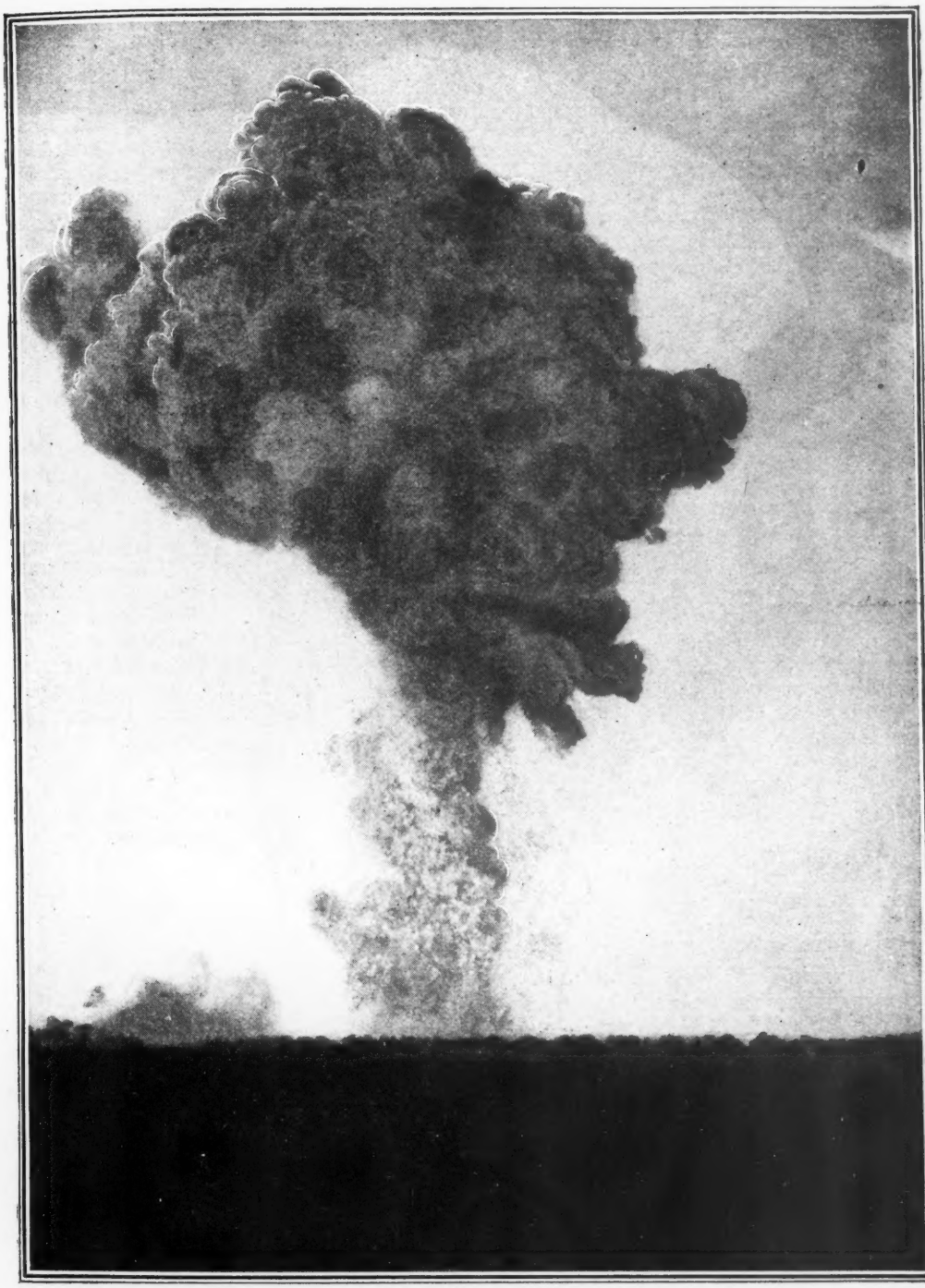
The grenades of the Mills type are egg-shaped, about four inches long and nearly three inches in diameter. The outside shell is of cast iron and deeply notched. The fuse and the ignition device are enclosed in a separate tube which is inserted into the outer shell and secured by a screw thread at one end.

The inner core consists of two parallel tubes connected by a U. In the wider of the two tubes is a plunger or striking bolt surrounded by a spiral spring which has the tendency to press the bolt against the ignition cap. The bolt is drawn away from the cap by overcoming the pressure of the spring and is held back by a trigger or firing lever locked securely by a pin to which a ring is attached. When the grenade is to be used, the locking pin holding the firing lever is pulled out, and the man clasps his hand around the shell, to prevent the lever from moving. When the grenade is thrown, the firing lever under pressure of the spring around the striking bolt flies up, releasing the bolt, which is flung down upon the ignition cap by the action of the spring. The cap explodes and ignites the time fuse, a slow-burning powder, which communicates with the detonator in the upper end of the narrower part of the U. The detonator causes the lyddite or other powerful explosive with which the grenade is loaded, to explode. The grenades now used by our allies may differ in small details, but the main features are alike in all. There is a good reason for the deep notching of the outer shell. It is that when exploded the grenade may break into many pieces.



Pineapples of death. The notches cause the grenade to break into many pieces

When Fifteen Million Grenades Exploded



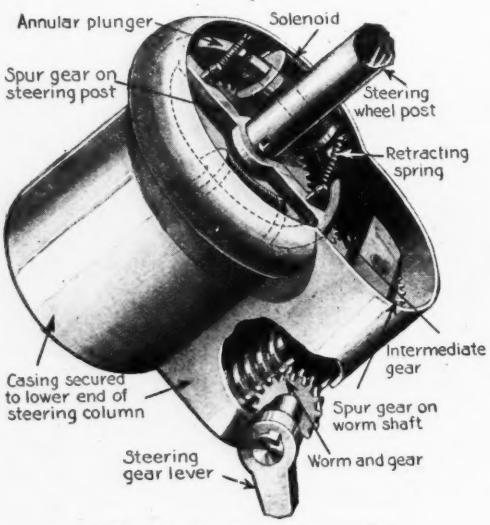
Shortly before two o'clock on a recent afternoon all Paris shook. A few moments later the terrified populace saw a gigantic column of smoke rise to a great height like the cloud of dust and smoke sent up from an active volcano. What was it? Fifteen million hand grenades had exploded at Courneuve, outside of Paris. Residences and factories were destroyed or damaged for a distance of thirty miles; more than thirty people were killed, and hundreds injured by the explosion

A Push Button Works the Steering Gear

The second prize in the Popular Science Monthly's automobile labor-saving contest was won by this electrical steering control

THE winner of the second prize in the POPULAR SCIENCE contest for the best labor-saving automobile device (the conditions were published in the April issue), devised an electrically-operated and controlled automobile steering wheel, which is operated by a mere push of a button switch in almost the same manner as you would turn on and off an electric light in your home.

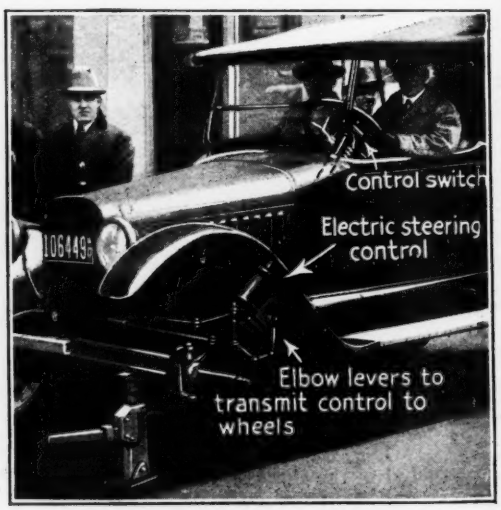
P. C. Haas, of 420 South Division Street, Ann Arbor, Mich., the second prize winner, uses two solenoids with plungers connected up with an arm on the steering-post column. By varying the amount of current passed through the solenoids, the pull on the plungers is varied to turn the arm and with it the steering column in much the same manner as the traces of a horse pull the ends of a whiffletree. This principle is clearly shown in the line drawing given on this page.



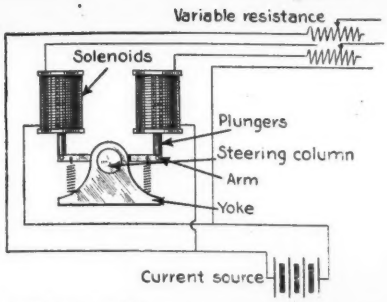
The electrical steering control and how it guides the car

In its application to the automobile, however, the principle is worked out somewhat differently for the sake of adaptability and to take up the least space possible. As shown in the perspective illustration, the device is made up into a cylindrical case attached to the bottom of the steering post column. At opposite points inside the casing are two curved solenoids, through the centers of which is inserted an annular plunger pivoted to the steering shaft. Variable resistance coils, enclosed in a small case, are carried in some convenient place on the automobile. To each of the two solenoid circuits one of the resistance coils is wired. When the resistances are the same, the current passing through the solenoids exerts an equal pull on the plungers attached to the steering arm so that the wheel is held in its normal and straight-ahead position. If the resistance of one solenoid is diminished the balance is disturbed and the other solenoid will exert a pull on the arm, thereby turning the steering post and the front wheels. By manipulating the resistances the car may be steered just the same as by hand. A train of three gears transmits the motion of the steering post to the steering crank and to the cross rod attached to the steering knuckles on the wheels.

The attachment of the electrical



The steering wheel is used only when the electrical control refuses to work



The wiring would be practically the same with ring-shaped plungers

steerer does not interfere with steering the car by hand in the usual way. The regular steering wheel is left in its place both for looks and as a means of steering in an emergency, should the electrical steerer become inoperative at any time.

The invention is interesting because it is in such perfect accord with the modern tendency of automobile inventions to promote efficiency and at the same time save man-power by making machines and mechanical devices do as much as possible the physical labor heretofore done by human or animal muscular power.

The vacuum cleaner can do its task quickly and thoroughly so long as the machine runs

Sucking Dust and Lint from Moving Machinery

THE constant and rapid accumulation of dust and lint on and in the machinery has always been one of the most vexing problems in spinning and textile mills. Small particles of wool, cotton, linen or some other fiber become detached from the yarns and threads during the spinning or weaving operations. The drafts produced by the moving machinery and other disturbing influences carry these small particles in every direction, and the whole air in such mills becomes filled with dust and lint. The presence of these impurities in the air is highly objectionable. It endangers the health of the employes and clogs the delicate machinery.

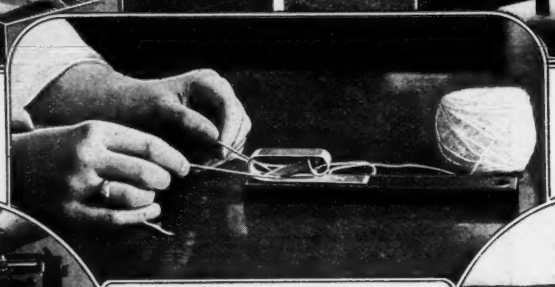
The workers in the mill can protect themselves by using respirators or any simple air filter. But to prevent the machinery from becoming clogged it must be cleaned from time to time and the cleaning, to be effective, must be thorough. All that takes time and labor and reduces the productivity of the mill. The invention of the vacuum cleaner has been a great boon to the textile mills. It has made it possible to remove the dust and lint from practically every part of the machinery more thoroughly, in a shorter time and without stopping the work for hours at a time. All this means greater efficiency, a saving of time and money and, incidentally, a diminution of the fire risk, because the lint does not collect and become soaked with oil, a condition in which it is subject to spontaneous combustion.

Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

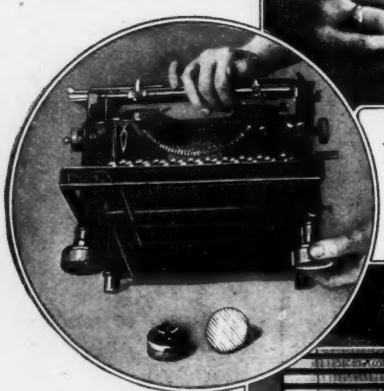
Saving Time and Trouble in the Office

Drawers of filing desk are fitted with accessible pockets which are labeled

This typewriter desk has a light, springless table for the typewriting machine

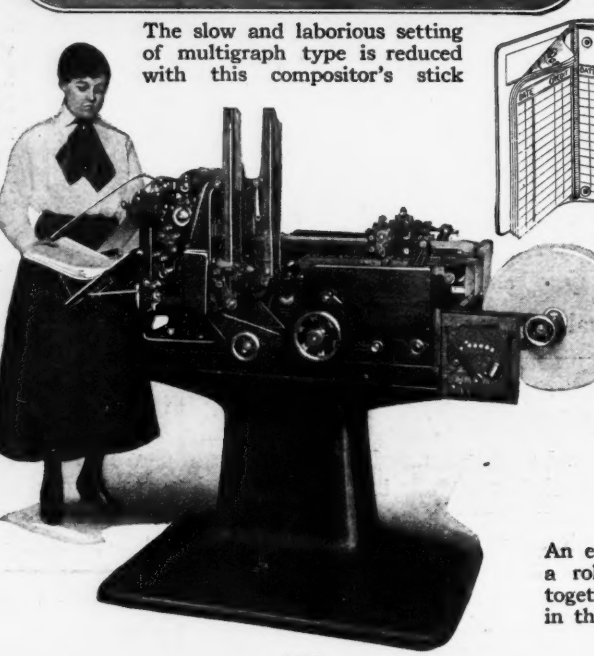


Cord-cutter that may be placed on a counter or hung on a wall near the package wrapping table

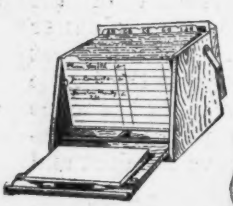


An efficient pad for the typewriter feet to prevent creeping as well as noise

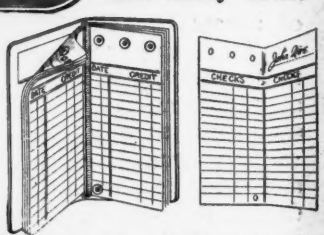
Problems in designing reinforced concrete solved with this handy device



The slow and laborious setting of multigraph type is reduced with this compositor's stick



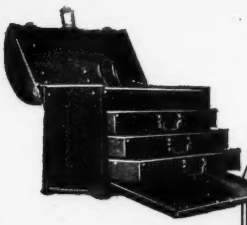
Handy desk reminder in which cards automatically present themselves as the calendar cards are removed every day



A loose-leaf bank pass book in which the leaves may be removed from the cover and placed in an adding machine

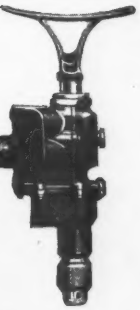
An envelope is cut from a roll of paper, pasted together and addressed in this elaborate machine

Do It with Tools and Machines

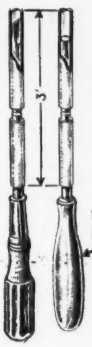


A very neat and durable tool box for mechanics, which is made of sheet metal and is enameled

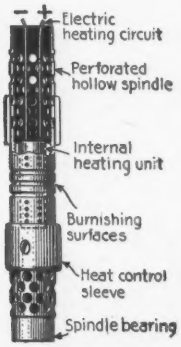
Tedious task of hand rubbing to finish surfaces is displaced by this electric machine



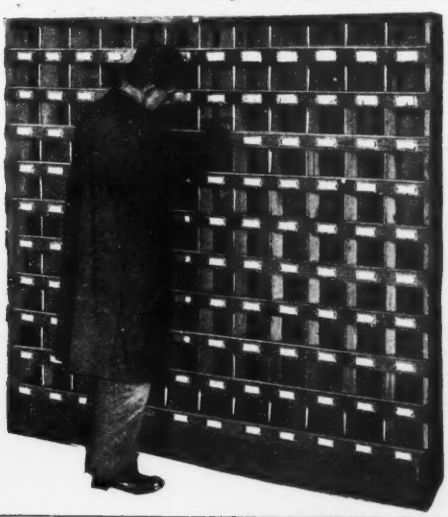
Pneumatic drill especially adapted for use in garages



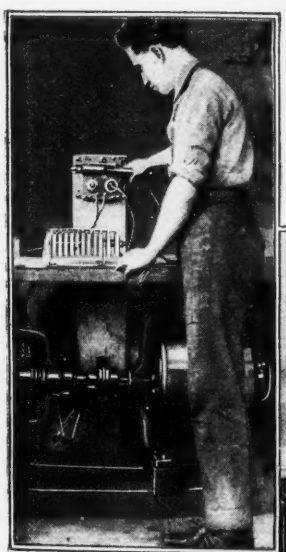
Screwdriver and hammer with long handle extensions for overhead work



This tool has a revolving spindle for burnishing leather

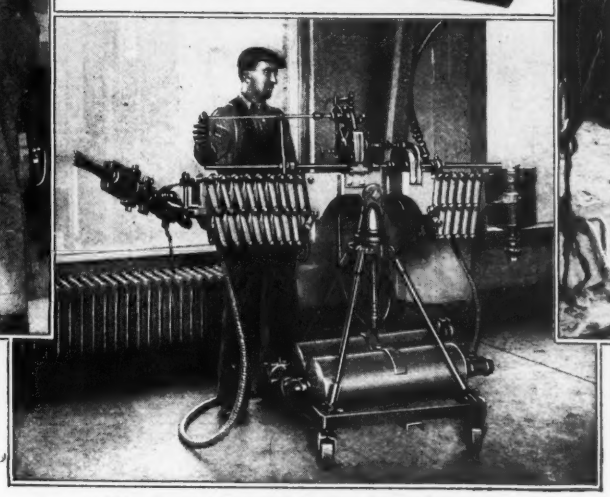


Pigeon holes for the shop to hold nuts, bolts, screws and small parts, are shown in the center

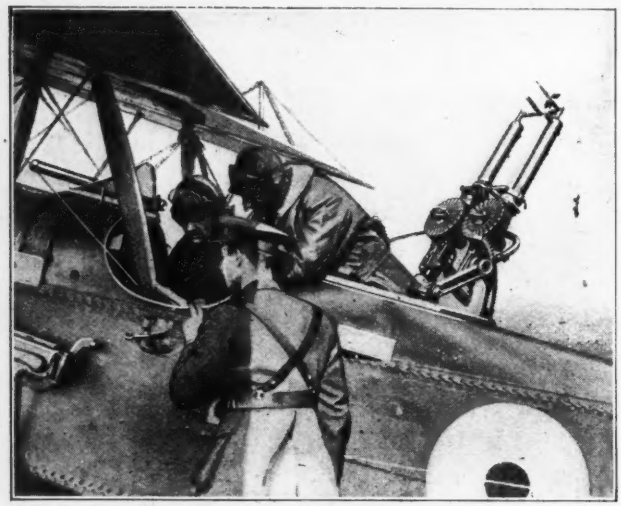


He is soldering with electricity, having soldering-iron holder

Here's the pneumatic calking machine for rapid work on ship hulls



A drilling machine outfit with lazy-tong arms. Storage tanks are used to maintain pressure



© Underwood and Underwood

No wonder they call them "binocular" machine-guns. When mounted, don't they look like field glasses?

Like Opera-Glasses—That's How Guns Are Mounted on Planes

WHEN the airplane was first introduced as an adjunct to warfare it fulfilled not even theoretically the requirements of a weapon of attack or defence. Experience proved an efficient teacher and under the stimulating influence of necessity the development of the military airplane progressed with remarkable rapidity.

One of the most striking evidences of growing maturity is presented by the fact that the armament of modern military airplanes no longer bears the character of an improvisation, but is constructed and mounted for a definite purpose and in conformity with the technical requirements of just such a fighting machine.

The new twin guns, known as "binocular" machine guns, which are shown in the accompanying picture, show no trace of being improvised. They are unmistakably constructed and mounted for aerial use and every detail of their construction was suggested by previous experience. An excellent feature is the circular magazines, which are far superior to the old cartridge belts because they interfere less with the rapid swiveling of the guns.

Uncle Sam's Hat Is in the Ring—and Winslow's Airplane Proves It

LIEUTENANT ALLAN F. WINSLOW of Chicago will go down in history. He is the American who brought down the first German flying machine credited to our Expeditionary Force. The insignia seen on the side of the flying machine shown in the accompanying photograph eloquently conveys the idea that Uncle Sam's hat is not only in the ring but that it dominates the ring exclusively. This will be demonstrated more and more conclusively as our aircraft construction program progresses from day to day.

© Kadel and Herbert

Lieutenant Allan F. Winslow of Chicago and the flying machine in which he brought down a German airplane

Those of us interested in science, engineering, invention form a kind of guild. We should help one another. All the specialized knowledge and information of the editorial staff of the Popular Science Monthly is at your disposal. Write to the editor if you think he can help you. He is willing to answer questions.

Making a Sport of Grenade-Throwing

The grenades are like those used in the trenches—without the explosives

HAND-GRENADE throwing, conceived in the stress of war, born in the trenches through necessity and developed to the point of a fine art by constant practice, has been taken up as a sport far from the maddening din of battle and is rapidly gaining in public favor. The grenades used in the sport are made of cast iron and weigh exactly twenty-two ounces each, just like the real hand-grenades used in trench warfare, but minus the explosives.

To aim a hand-grenade correctly is not quite so simple as one may think. To throw the grenade successfully the thrower must learn the carefully worked-out style of delivery which utilizes all the muscles of the body and puts the full force of the body behind the throw without laming the arm. The grenade is too heavy to be pitched like a baseball.

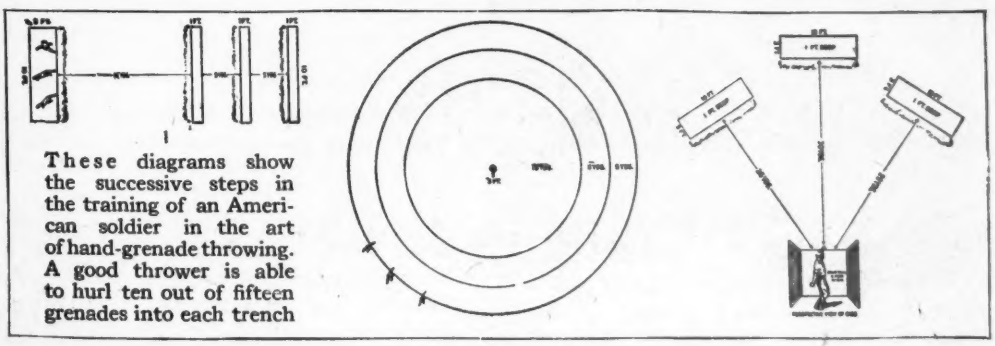
You throw the grenade by rocking the whole body—not like a baseball

The position of the soldier in the picture is that immediately preceding the throw. In delivering the grenade the right knee is straightened, the whole body swung forward and, while the extended left arm is swung down and to the rear, the right arm describes an arc toward the front, throwing the grenade over the head. The muscles of the legs, the arms and of the body coordinate their efforts in this throw, but it requires some practice to become proficient in this style of delivery.

The three diagrams illustrate the method adopted by the United States Army to make hand-grenade throwers proficient. The simplest consists of a throwing trench about one foot deep, three feet wide and ten feet long. Fifteen yards directly in front of this trench is another trench 10 feet long, one foot wide and one foot deep. At twenty yards and also at twenty-five yards similar trenches are constructed. For the next step in the training the circular arrangement is used.

Around a "bull's eye" of three feet diameter three concentric circles are drawn at 15, 20 and 25 yards from the center. The men are placed at suitable distances from one another—first on the 15-yard line and, as their proficiency justifies it, on the more distant lines.

For the final test an arrangement like that shown in the third diagram is used and practice is allowed therein.



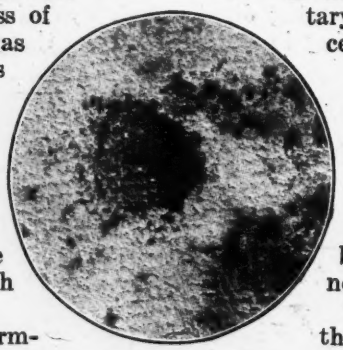
These diagrams show the successive steps in the training of an American soldier in the art of hand-grenade throwing. A good thrower is able to hurl ten out of fifteen grenades into each trench

Like a Duck's Back

Proofing the cloth used for war purposes against water and mildew

By John Walker Harrington

TENTS and uniforms for the army must be proof against both moisture and mildew. These are days in which the dampness of trench and dugout, as well as the rains and the snows, plays havoc with materials and fabrics. Shoes that have been brought back are moldy; a greenish coating clings to them, composed of minute plants—the malignant microbes which cause the disease known as "trench foot."



Sample of mildew growth one month after inoculation and incubation

The various mildews or harmful molds are composed of tiny enemies of mankind. Unless equipment is made as near proof against them as possible disease will result. The Bureau of Chemistry of the Department of Agriculture has been assisting the War Department in devising protection for all kinds of fabrics used for military purposes. At the recent Textile Exhibition, held at the Grand Central Palace in New York City, a well-known biologist and chemist representing the Bureau of Chemistry, demonstrated a novel method by which it can be ascertained whether or not a fabric will mildew.

The first step is to obtain the seeds or the spores of the small organisms which cause mildew.

A small piece of spoiled fabric, taken either from a tent or a molded tarpaulin, contains myriads of the spores. They are separated from the cloth and spread upon a small quantity of jelly made from Japanese seaweed agar-agar or from Iceland moss. This jelly is mixed with highly nutritive substances which are just as agreeable to the bacteria as they would be to a boy who is fond of jelly-like desserts. In this rich medium the molds grow rapidly, and millions of the mildew spores are developed.

Testing tent canvas to determine whether it will shed water running over it or not

Killing Mildew with Copper Salts

On top of the layer of the nutrient agar jelly has been laid a small disk of the cloth to be tested. If this sample has not been properly protected, the mildew will soon attack it. The chemical treatment of cloth which the spores dislike most of all is a cupro-ammonium treatment, frequently called the Willesden process, which is commonly employed in England. This powerful copper salt clings to the very fibers of a fabric and gives it a light greenish color, which is often disguised by the addition of brown, khaki or any other dye. Specimens of cotton duck treated in this

manner have withstood the attacks of the hostile legions of mildew and bacteria without the loss of a single fiber.

As tents, uniforms and all cloths must withstand considerable moisture, the chemicals used to protect them against mildew must remain in the mesh. Before the Government experts throw the textile Daniel into the glass den of the ravening bacteria they wash it thoroughly in clear water. The rinsing process takes out carbolic acid or any other readily soluble germicidal chemicals. This preliminary test is the equivalent of one good drenching.

Scraping mildew germs from an infected tent canvas to make a test of their rapidity of growth

It does not take very long for the destructive effects of the mildew to become evident. Little colonies form on the surface of the sample, and if the cloth is poorly protected, they will have practically destroyed it before the expiration of thirty days, assigned to the test. Even if the damage appears to be slight, the fabric has frequently been so weakened that if it were used in a tent the water would soon be leaking through the affected places. Some of the specimens inoculated in the Government laboratories look worse than shreds of mummy cloth taken from the tombs of the Pharaohs.

Manufacturers who saw these exhibits and especially the horrible examples, arranged for a select line of mildew tests of their own to be made in their establishments before sending their goods to the Bureau of Chemistry to be passed upon for Government contracts. As a result of this activity all kinds of cloth are already being standardized. This saves a great deal of time for all concerned.

Inoculating the agar-agar jelly with mildew germs from canvas

It is very essential that a tent should withstand moisture; for the Government buys nothing but waterproof canvas. Resistance to water must be obtained by virtue of the weave of the fabric itself. It cannot rest upon sizing or the introduction of undesirable foreign substances into the texture. The Federal experts take a large square of the material to be tested and make it into a conical bag. On the outside of it they place a paper filter and then put the two into a glass funnel. The funnel is supported by the iron ring of a filter rack. It is then filled with water and the surface of the fluid is maintained at the same level by a supply of water contained in a bottle which is turned upside down over the top of the funnel. Cloth is a hundred per cent. water-resistant if after five days of this test no moisture has seeped through it and no trace of dampness is to be seen on the sensitive outside filter of paper.

Will This Tent-Cloth Stand Water?

Under the spout of the funnel is a graduated glass cylinder in which the amount of water passing through a sample may be accurately measured. In some grades of canvas the Government will accept goods through which there is a slight leakage under these test conditions.

From a tent the water is supposed to run as easily as it slides from the back of a duck. In order to make sure the examiners

attach a square foot of the cloth undergoing the test to a wooden frame. Underneath the fabric is a layer of highly absorbent paper. The frame is slanted at about the angle of a tent flap. There is then placed over the sample a small glass tube which is connected with a tank of water. By means of a glass faucet the flow of water is so regulated that it comes in a stream delivering a definite amount in a given time. The fabric which undergoes this ordeal without absorbing moisture for six days, may be regarded as a very effective protection against the elements.

If the water doesn't seep through, the canvas is good

Arrangements are also made for subjecting samples to a continuous downpour of water equivalent to a tropical rain storm. Specimens are also actually exposed to the weather for long periods so that the effects may be reckoned for service conditions.

In addition to the tests which have been here described, the Government also subjects the yarns and threads of the various fabrics to elaborate examination to determine their tensile strength.

By the time textiles are ready to be made into tents, uniforms and equipment they may be considered as above suspicion.

The Mysteries of Liquid Fire Are Explained

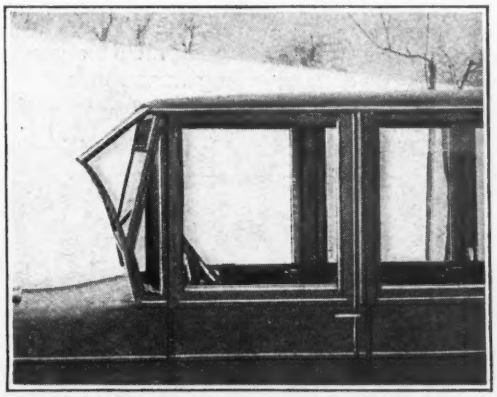
A LIQUID fire apparatus usually consists of a metal tank holding about four gallons of liquid to be burned, a section of pipe from this tank to a rubber hose at the other end, in which there is a smaller metal pipe about a yard long fitted with a nozzle, and a friction igniter, as well as an oil burning wick. There is a valve near the tank and another near the nozzle. Benzol, from coal tar, and crude oil, are used in equal proportions and are carried in the tank under a pressure of approximately three hundred pounds per square inch, this pressure being maintained by compressed nitrogen, an inert gas having no effect upon the contents of the tank. The tank and accessories are carried by one man, while the nozzle is carried by a companion when liquid fire is being burned.

In use a cap is drawn from the end of the nozzle and a wick burning kerosene or similar oil is thereby lighted, since the cap is a friction igniter. The oil is then turned on and is ignited as it leaves the nozzle under great pressure. The result is a flame of burning oil about thirty yards long. For two-thirds of this distance the flame is straight, but it then turns up as does any other flame. The flame may be directed against the ground, but care must be taken not to deflect it too sharply as it may strike the ground and turn back toward those operating the device. It is therefore not well suited to turning down into a trench.

It is claimed by an expert from the American Chemical Society that liquid fire is not so effective a weapon now that it is understood by the troops and means for defense have been worked out. It can be readily understood, however, that a number of such devices, with the roar of the escaping oil, when used together, give a means of demoralizing the defenders of a trench, especially at night, and in the beginning was a valuable accessory weapon of offense, especially for raiding parties.
—H. E. Howe.

Windshield and Sunshade in One. It Works with a Twist of the Wrist

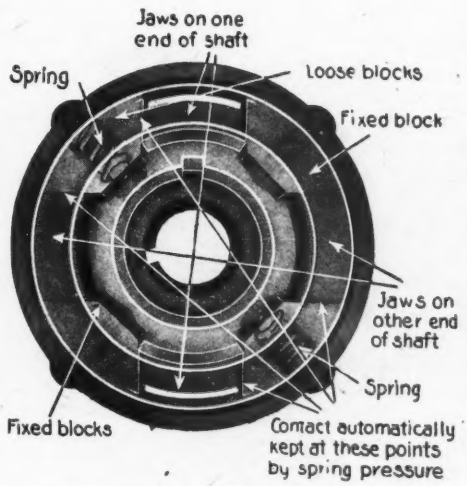
A NEW windshield slides upward by means of two threaded bars, one on each side. Its advantages over the ordinary shield hinged at the top are obvious. When it is desired to open the windshield for fresh air or clear vision, it is pushed up only as far as needed, whereas the shield hinged at top, in order to obtain, say, two inches of open space, would manifestly require to be pushed outward a great deal further than that, thereby letting in rain or wind or snow. This new type of windshield is also provided with a canvas awning serving as a sunshade.



The windshield slides upward and it has a canvas sunshade slanting outward at top

Taking Up the Wear in a Magneto Coupling by Means of Springs

IN driving water pumps and magnetos on automobile engines, it is necessary to provide some method of compensation for any possible misalinement of the pump or magneto shafts with the driving shafts. While the usual type of two meshing jaw-clutch ends has given good results it wears away because of the metal to metal contact and becomes a noisy consumer of power. To eliminate these difficulties, the new type of coupling shown in the accompanying illustration is provided with two loose triangular-shaped jaw members carried on springs extending through the circumferential band holding the jaws in place. Because of the pressure exerted by the springs, the loose jaws hug the fixed ones and automatically take up any wear between the two parts.



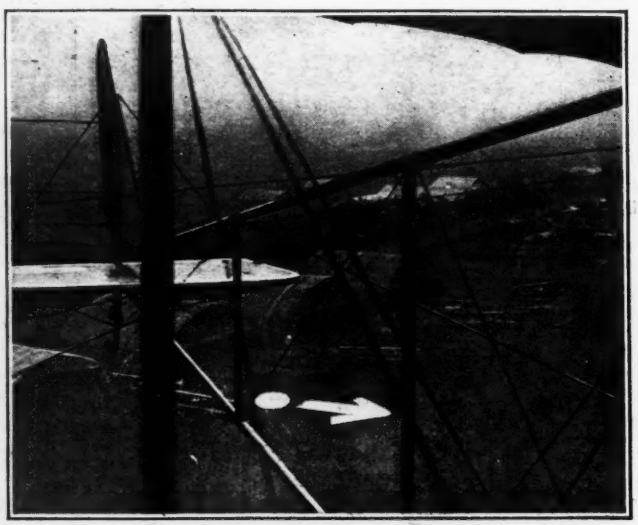
Because of the pressure exerted by the springs, the loose jaws of the magneto coupling automatically take up the wear

How to Make an Old Car Pay

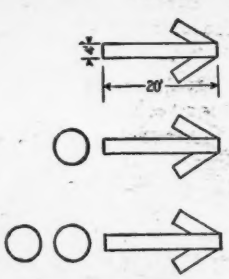
THE experience of an automobile owner, as told by himself in a magazine devoted to automobiling, should be of particular interest at the present time to owners of old cars. The man in question, a farmer in Ohio, had bought a touring car in 1910 and had used it five years. He tried to trade in his old car as part payment on a new car, but he could not obtain the conditions to which he considered himself entitled. He purchased the new car outright and kept the old one. He converted it, at small cost, into a truck which has given him good service ever since. Every day he takes the milk from his dairy to the city and on the return trip brings feed and supplies back to the farm. He also uses the car a great deal for business trips connected with his farm work. He also purchased special tractor wheels and used the old car as a tractor for plowing. He found that it saved him time, labor and expense. Seeing that he could do without horses, he sold the three he had at a good profit for more than the car cost him and saved on their feed.

Arrow System Used by England in Guiding the Chariots of the Air

THE Germans are raiding England from the air so frequently and at so many different places that they often get by the coast patrol. Should a hostile airplane cross over his beat unknown to him, which often happens, as the distance to be patrolled is generally long, coast guards on the ground instantly notify him by means of a simple signaling system. He will see below him a white canvas arrow, twenty feet long, pointing in the direction taken by the enemy aircraft. If it is five minutes since it passed over, one circle is placed behind the arrow. After a further five minutes interval a second circle is added. Twelve minutes after the signal has been displayed it will be taken in, unless the enemy airplane is within range of a faster Allied airplane or is returning. As in the schoolboys' hare-and-hound paper chase, the British pilot has only to follow the arrows which are prominently displayed on the ground, until he sights the enemy.



The white canvas arrow in the picture points in the direction taken by an enemy airship. It is 20 feet long



One circle means five minutes have elapsed since he passed. Two circles mean ten minutes

At night, flares are arranged in the form of an arrow, the circles, however, being omitted. One objection to using this system at night is that often these flares are mistaken by the pilot for those displayed at a night-landing aerodrome. Searchlights are also a useful guide to the trail of the invader and are always turned in the direction in which the enemy airship was last seen.

How They Husband the Gasoline Supply in France

GASOLINE is extremely scarce in France, and its use for other purposes than those of war has almost ceased. The army is, of course, supplied with all the gasoline required for the military automobiles, airplanes, motorcycles, and motor-trucks in actual service, and a limited quantity is allowed to civilians who can prove that they need the gasoline for some legitimate purpose. To prevent the sale or the giving away of army gasoline to favored civilians the Government has resorted to the expedient of coloring all military gasoline red. A dyestuff is used which gives a distinct coloring without interfering with the quality of the gasoline. In one of the army services at the rear red gasoline was tested with the result that the average consumption dropped immediately. This proved that gasoline had formerly been sold or given away to civilians.

A Hailstorm of Bombs

A statement issued by the British War Office gives the following interesting data regarding the comparative number of bombs dropped by aviators on both sides during a single month. In the area occupied by British troops in France during that period German aviators dropped 1,482 bombs, while British airmen let loose 7,653 bombs over German-occupied areas in the same time.

How Much Light Falls on Your Desk?

Lay this instrument on the table and measure illumination

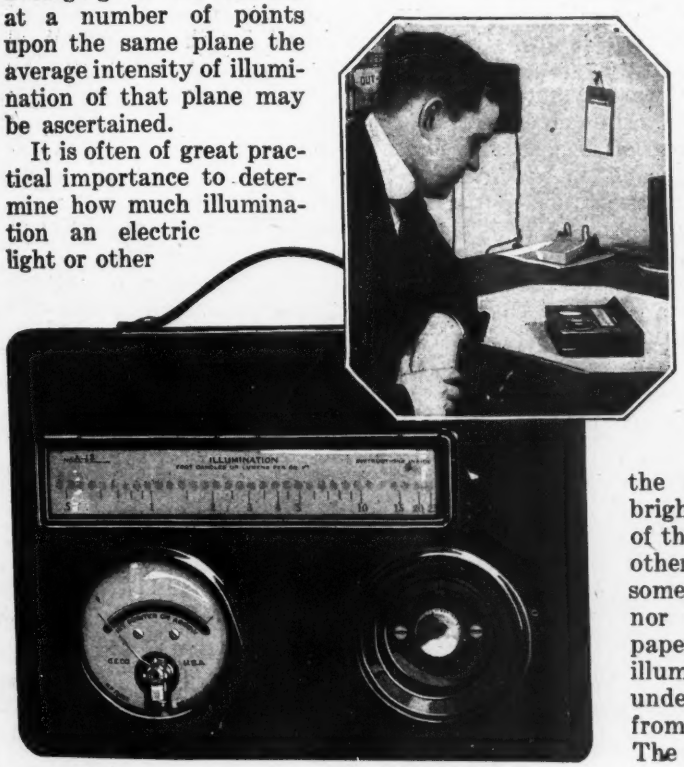
TO measure anything you must have some standard of length, weight or capacity with which to make comparison; you must have what is called a unit of measurement. The bushel, the pint, the foot are such units of measurement. The unit by which the intensity of light is measured is called candle-power.

But light is one thing, illumination another. Light may be called the cause, illumination its effect or result. The unit of measuring the intensity of illumination of any surface is called a foot-candle. A foot-candle represents an intensity of illumination equal to that produced by one standard candle at a point upon a plane one foot distant from the candle and perpendicular to the light ray at that point. The foot-candle is a unit which applies to a point on a surface. By averaging the foot-candles at a number of points upon the same plane the average intensity of illumination of that plane may be ascertained.

It is often of great practical importance to determine how much illumination an electric light or other illuminating source will give at a certain point, be it a desk, a drafting table, a workbench or a sewing-machine, the position of which relating to the source of light can, for some reason, not be changed. An instrument, called a foot-candle meter, has recently been designed, which measures foot-candle intensities quickly and with a fair degree of accuracy. It is very simple in operation and so light that it can be easily carried about. The instrument is placed upon the surface the illumination of which is to be tested, the lamp is adjusted and even an inexperienced eye can read the foot-candle intensity from a scale.

A long and narrow opening in the instrument box is covered with a strip of opaque white paper or cardboard, upon which the graduated scale is printed. A number of small, round holes, corresponding with the graduations of the scale, are covered with transparent paper. Beneath one end of the perforated and graduated strip of paper, is a small incandescent lamp, which, placed at one end of the strip, illuminates one end of the strip with greater intensity than the other.

The device is placed so that the light falls upon the scale screen. The translucent spots of the strip at one end appear brighter than the white paper of the scale, while those at the other end seem darker. Find some dot that is neither lighter nor darker than the opaque paper of the scale. There the illumination by the lamp from underneath and the illumination from above are equally intense. The scale gives at a glance the foot-candle intensity corresponding to that dot.



He lays the instrument on the table and it tells at a glance how much light falls on his desk

The game combines English cricket, American baseball, and a few other games

Cricket and Baseball Combined—A New Outdoor Ball Game for Boys

A NEW ball game has been invented, which is particularly designed for boys between the ages of eight and fourteen or thereabouts. The new game, which requires only a moderately large space, may be played by two or more boys, either for independent scores or as teams. It combines features of English cricket, American baseball and a few other games in a form suitable for athletic girls as well as boys. The equipment is simple and inexpensive; it consists of a bat, twenty-three inches long, with flat sides; a soft rubber ball, somewhat heavier than a tennis-ball; two wooden disks, five inches in diameter, to mark the bases; a net, two feet square, supported by stakes driven into the ground; and a rocker, which throws the ball into the air when one end is struck by the bat. No special clothes are required.

The rules are as simple as the equipment. The home base is put three bat lengths in front of the net, the field base twenty-five to thirty-five bat lengths from the home base. The batter throws the ball in the air by means of the rocker and bats it toward the field base. He is "out" if he misses the ball three times in succession.

After batting the ball, the batter runs to the field base and back to the home base. The fielders, whose place is beyond the field base, seek to put the batter out by catching the ball on the fly and throwing it into the net before the batter can return to the home base and bat some more.

Man-Power Is Cheap in the Philippine Islands

IN the Philippine Islands labor is still cheap and for that reason it is often employed in cases which, in the United States, would call for the use of labor-saving machinery. The accompanying picture illustrates the manner in which big logs are transported across the vast stretches of swampy ground which interfere with communication in many parts of the islands. Sometimes more than one hundred men are hitched to one of these big logs to drag them across the marshes. Enterprising Americans have tried to use automobile trucks but the roads were too swampy for them.

Labor like this is plentiful and cheap in the Philippines. What's the use, then, of machinery?

Making It Easy to Remove the Large Globes of Street Lamps

BREAKAGE of the large outer globes of street lamps is reduced to a minimum by the use of a new clamp recently invented. The holding device consists of two sheet metal semi-circular forms connected at one side by a hinge and at the opposite side by a catch. The inner edge of this form is shaped to fit the flange of the globe, while the outside edge fits over the collar of the post. Three L-shaped slots on the outside edge of the form allow it to slip over the holding screens that project outward through the collar of the post.

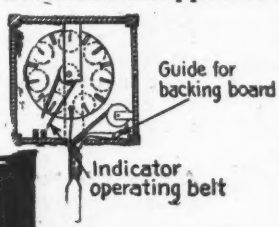
Showing how the clamp encircles the neck of the globe, and holds it fast

The form, clamped to the globe, is placed on the post, turned into position, and held securely in place by lugs!

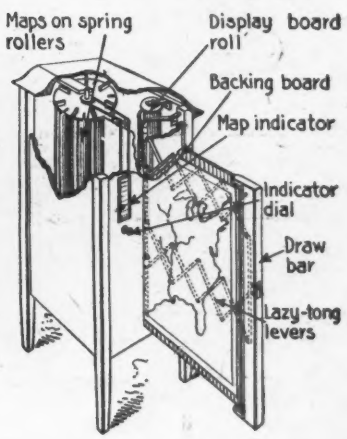
Select Your Map with a Dial and then Pull—That's All

A CABINET that can contain a number of maps on vertical rollers, and display them as wanted on an extension board which can be folded back within the cabinet when not in use, has been devised and patented by George S. Clason of Denver, Colorado. The illustration shows the cabinet with board extended to display a map. The maps are held in a cylindrical container, each map being mounted on a spring roller. On the outside of the cabinet is an index of the maps contained therein, and the operator has simply to turn a dial until an arrow registers opposite the number or name of the map wanted. The map is then pulled out on a draw bar by a system of rods and grippers which engage it. Thus extended, it is held rigidly on an extension board which is provided with a stopping device that holds it until released by the operator.

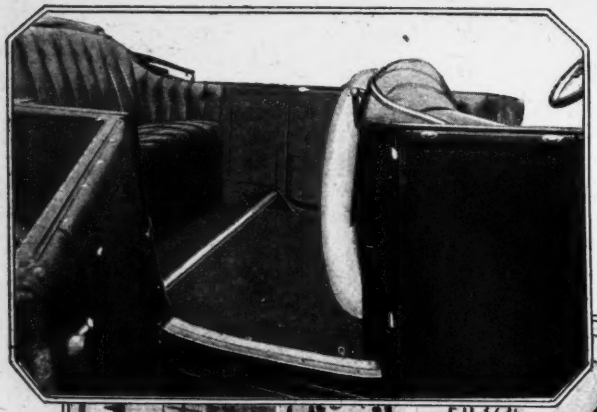
The extension board is composed of narrow strips hinged together, and the entire cabinet can be made of any material desired, whether wood or metal. This device should appeal to business men and engineers who must have at hand numerous maps and charts for reference.



The pictures show the general appearance of the map cabinet and details of its construction

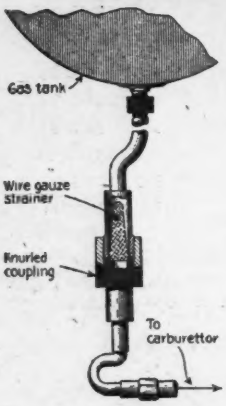


Live Topics of the Motor World

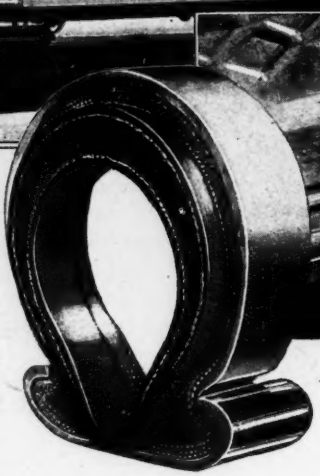


With this device a tire may be carried on the back of the front seat without discomfort to passengers

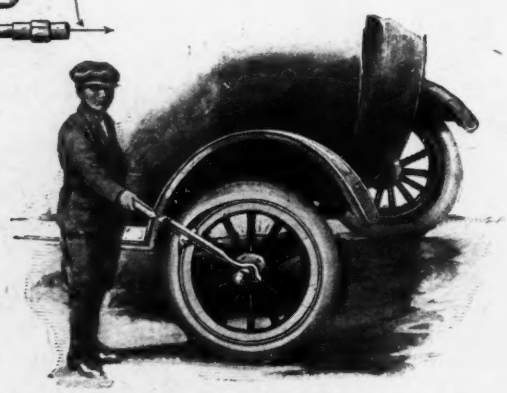
This van is twenty feet long, eight feet wide and eight feet high—largest ever built on a motor truck



At the left is shown a strainer placed in the pipe line between tank and carburetor on an automobile

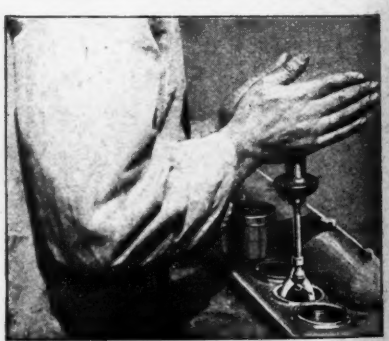


An inner tube with two layers of fabric in the rubber to prevent blowouts



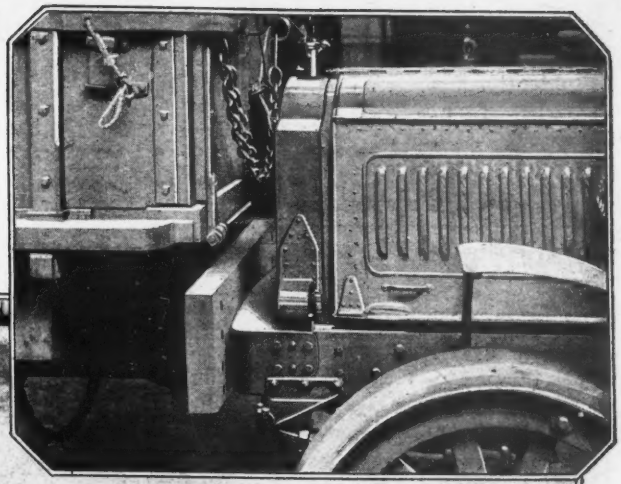
Lever attached to hub for revolving it as tire is removed from the bead on the rim

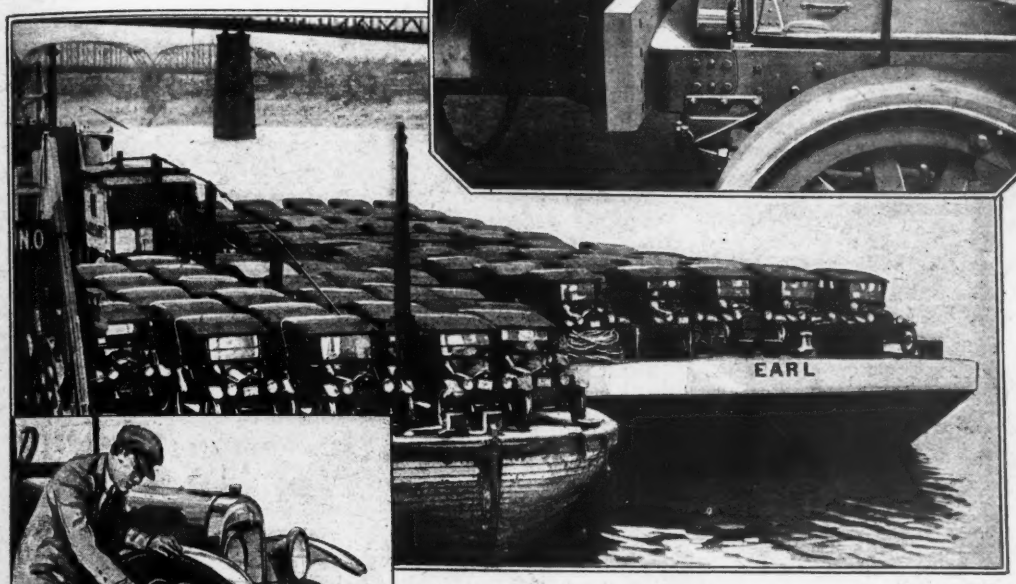
An adjustable valve grinder and manner of using it indicated



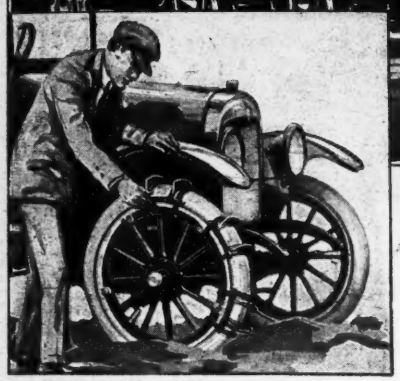
Live Topics of the Motor World

Both front and rear ends of heavy trucks are now provided with bumpers to save the radiators



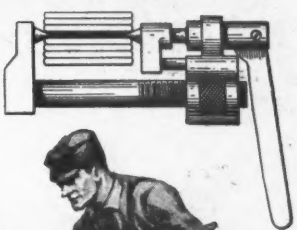


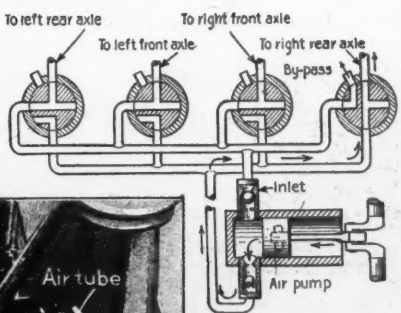
A shipment of over one hundred automobiles on barges from Cincinnati, Ohio, to Memphis, Tennessee

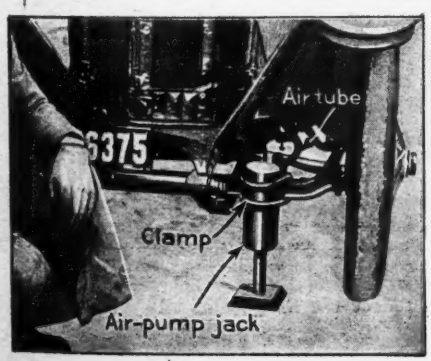


Double mud hooks for attaching to a mired tire. They can be applied at any place on the tire

Adjustable spring leaf spreader is shown at the right. The leaves are spread by lever action







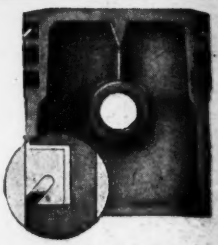
A set of four jacks is used under a car. They are operated by air and raise car from the ground

With a motor mounted on a low truck driving a flexible shaft and buffer auto parts can be cleaned

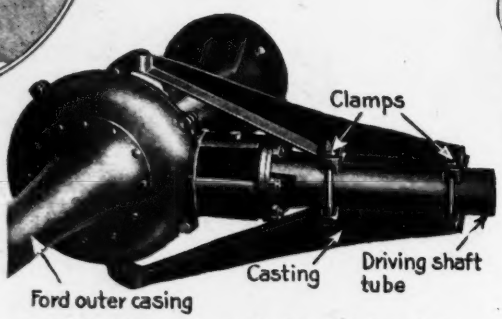
New Things in the World of Tractors,

One of the largest motor truck bodies ever built, is twenty-two feet long with a three-foot tailgate. The full length of truck is exactly twenty-five feet

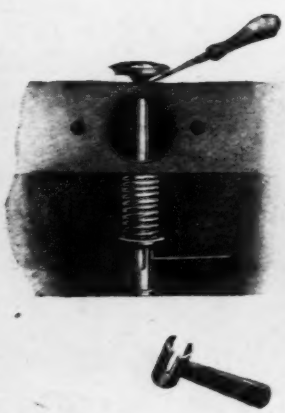
A four-fold purpose key for Ford cars. It can be used for a combination switch or gas tank key, vibrator wrench and screw-driver



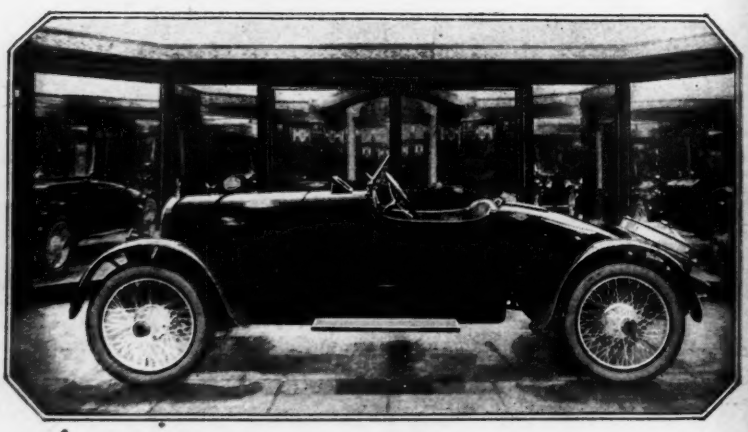
A groove cut in the sliding surface of a piston ring holds oil, making a perfect seal



With this brace attached to driving shaft tube of a Ford the shaft won't vibrate

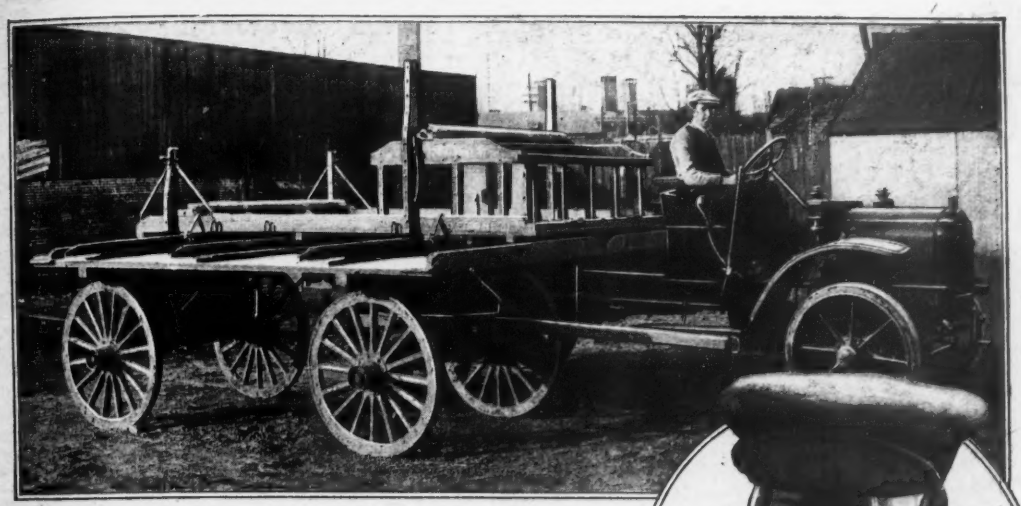


Valve lifter as placed under a valve spring



How does your car look to the man on the sidewalk? Eight mirrors in this showroom reflect the image and tell you

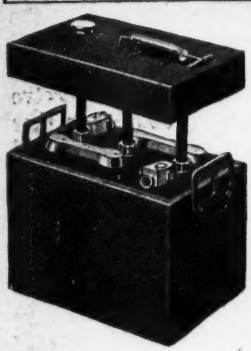
Motor Trucks and Pleasure Cars



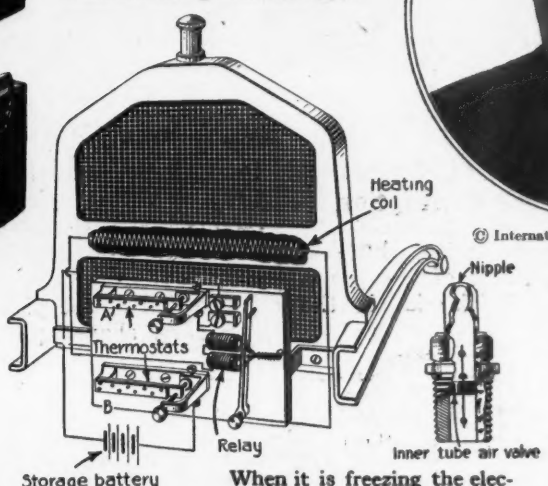
Transfer table for changing the entire body from a truck to a small horse wagon shown above

© International Film Service

A double piece visor for a cap. When the upper portion is raised the under keeps dust from the eyes

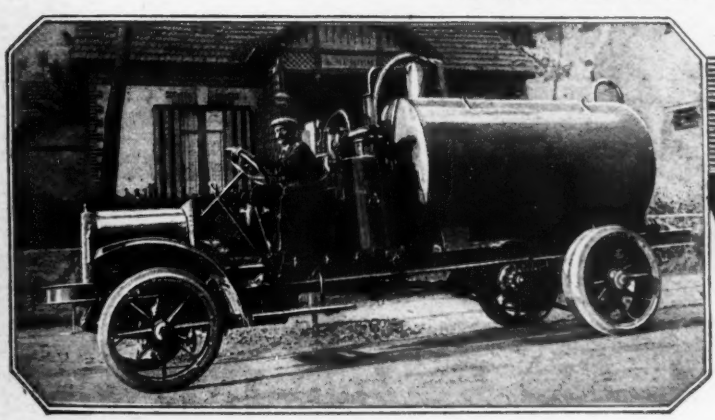


The removing or filling of the storage battery with water may be easily accomplished with this novel filler tank

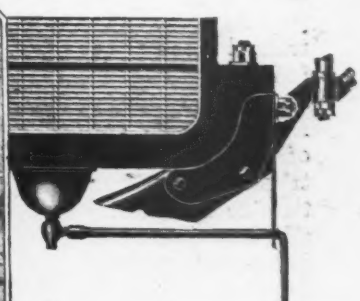


When it is freezing the electric device turns current on

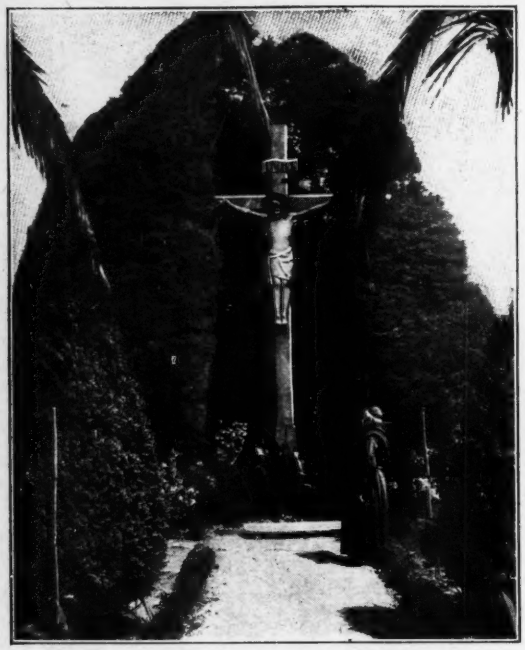
A plug attachment that you can place in the spark plug opening for obtaining the pounds pressure with a tire gage



An army scavenger truck which is used to pump water and filth out of the trenches on the battle front



Radiator drain used in connection with a tile in the floor to let the water out in winter



The Brother in the picture planted the group of cedars sheltering the crucifix 63 years ago

An Open-Air Shrine of Cedars—A California Priest's Conception

ONE of the numerous attractive features in the gardens of the Santa Barbara Mission in California, is the group of cedar trees forming the background for a tall crucifix, shown in the accompanying picture. The Brother in the picture planted the cedars sixty - three years ago and trained them to form an alcove around the crucifix. He has taken care of the trees and trimmed them from time to time during all these years and takes great pride in showing the sheltering group to the visitors of the Mission who flock thither from all quarters.

You May Injure Your Skin with Too Much Soap

DR. SAMUEL DIXON, Health Commissioner of Pennsylvania, asserts that the use of too much soap is injurious as it fills the pores with fatty substances which interfere with the activity of the glands of the skin. Very little soap is necessary to dissolve the dirt so that water can remove it.

Since soap has gone up in price there is still more reason for saving it.

A Game to Teach Children How to Read the Clock

MANY children find it difficult to become proficient in reading the clock. The subject is not in itself excitingly interesting, for which reason the instruction the children receive from their parents is usually rather perfunctory. The clock puzzle placed in the market by a novelty concern in Michigan offers an excellent method to make the study of the clock fascinating to children and at the same time instructive. As they play the children are familiarized with the clock and learn to tell the time of the day from the position of its hands.

The dial of the play clock is cut into irregularly shaped pieces after the manner of the picture puzzles. One side shows the dial with Roman figures, the other side with Arabic figures. After the dial has been assembled the movable hands are placed in position and the lesson in reading the time may begin. Just below each numeral is printed the time-equivalent in minnutes, as for example, "Five minutes after," "Ten minutes after," etc. The value of time may also be inculcated with each lesson.

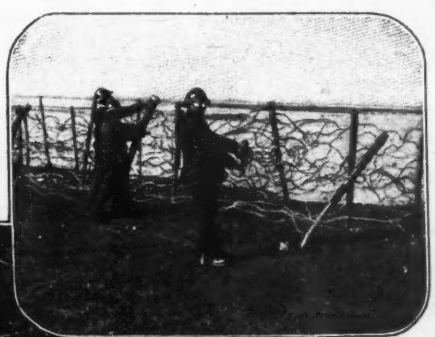
Teaching children mysteries of the clock by means of puzzle clock with movable hands

Getting Rid of the Barbed Wire Entanglement

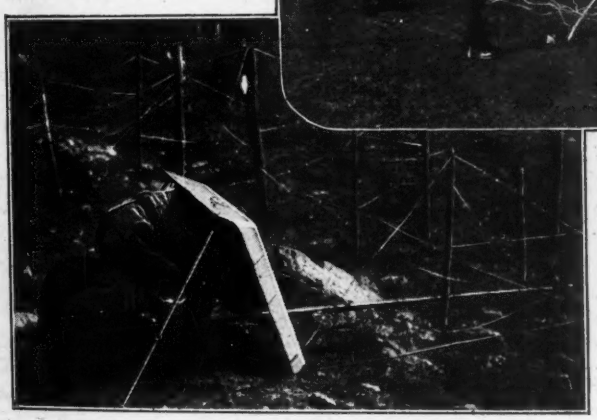
BARBED wire entanglements were first used in warfare by the Boers in their brief struggle with Great Britain. It was recognized at once by all the military leaders of the world that a new and very formidable method of checking storming troops had been devised by South African farmers who knew nothing at all of military strategy. By the time the Russian-Japanese War broke out elaborate methods of installing barbed wire entanglements had been evolved.

It became apparent that wire-cutters would become an indispensable part of an infantryman's equipment. But it was also recognized that the cutting of barbed wire, in daylight at least, was almost suicidal. While artillery fire was the most effective method of destroying the entanglement, all the European armies have experimented with special entanglement destroyers. In England, France and Germany, these took the form of long poles at the end of which explosive charges were carried. England probably made the most extensive experiments of this kind, although the Russians proved themselves the more ingenious.

In one of the accompanying pictures an infantryman is shown advancing under the protection of a shield with one of these poles. If he gets to the entanglement alive (the steel of his shield is hardly thick enough to resist a machine-gun bullet) he will pull a kind of trigger or latch and explode the charge at the outer end of the pole in his hand. The destructive effect is far greater than would be possible if shears alone were used. As wires are often charged with electricity the long-pole wire-destroyer offers its operator some degree of safety.



Italian troopers erecting a barbed wire entanglement along the Piave. Wire stretchers are used very much like those with which our Western ranchmen are familiar



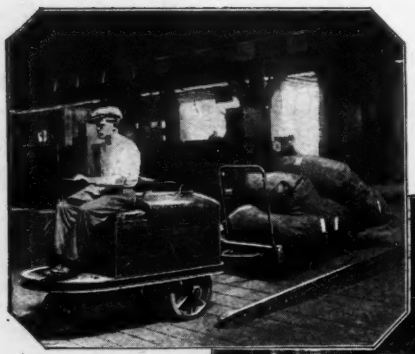
Infantrymen advancing under cover of a shield to destroy the enemy's barbed wire entanglements

Cherry Pits a Source of Valuable Oils

ABOUT 36,000 tons of cherries are grown annually in New York, Michigan, Wisconsin and California, of which eighty per cent. is canned. In order to can cherries the pits are removed, and in removing the pits juice is wasted. Some 1,600 tons of pits accumulate in a year, and 112,000 gallons of juice. Both are now wasted. But it will not be for long. A golden fatty oil, similar to the oil of sweet almonds, can be squeezed from the pits; it is worth $75,000. The cake left after squeezing can be treated to yield another oil, a volatile oil worth $10 a pound, and since 1,600 tons of pits would yield 6,000 pounds of this oil, the product is worth an additional $60,000. The residue after extraction of the volatile oil amounts to about 300 tons, worth $30 a ton as stock food. That makes $9,000 more. So the pits alone are worth a total of $144,000. Then, the juice would result in the production of about 5,000 gallons of alcohol, 21,000 gallons of soup or 85,680 gallons of jelly. The value of these it is difficult to appraise. At all events, the cherry industry must be wasting $200,000 a year. A chance for somebody to save this waste and make a fortune.

Electric Stevedores Relieve Congestion

How a simple invention is helping to increase our military and industrial manpower



The small tractor run by one man pulls the loaded trailers from the platform to the cars

General view of Pier 4, Pennsylvania R. R., Hudson River, New York City

The empty trailers are collected and taken back to the platforms to be reloaded for another run

SMALL electric industrial tractors would solve the problem of freight congestion of New York city's piers and incidentally release from five thousand to seven thousand men for other vital war work, even if only approximately fifty thousand tons of freight were handled daily. How do we know? Simply, by the wonderful results accomplished by only four such vehicles at one of the Hudson River piers. Before these mechanical means were substituted for human muscle in moving freight, the pier was clogged with goods. Now it is the least congested. Before, it required the services of one hundred and sixty-five men to move twenty-five carloads of freight, or two hundred and seventy-five tons. Now it requires only one hundred men to move forty carloads or four hundred and forty tons daily.

These wonderful results at a small expenditure of capital have meant advantages to the railroad, to the transfermen taking the freight to and from the piers, to the shippers and receivers of the goods and possibly to many inhabitants of the city, since the goods handled are consumed either as material to be manufactured, or food to be eaten. The railroad has been able to do more work with fewer men and at a lesser cost than formerly. The transferman gets his goods more quickly and is able to deliver them in a shorter period of time. This means an opportunity for increased work and greater profits.

While the success of the installation has been due primarily to the introduction of mechanical means, it depended to a great extent upon the manner in which they are used. The four industrial tractors are used in connection with two hundred and twenty-five four-wheeled hand-trucks. These trailers are disposed around the edge of the pier headhouse

which is made up in the form of a huge U. The inner area is a few feet lower than the platform extending clear around the base and arms of the U. No wagons or trucks are allowed on the pier. They must back up to the platform as shown in the accompanying plan view. The freight going out is handled on one pier and the incoming goods on the other, to avoid confusion. The U-shape of the platform gives double the unloading space of the ordinary straight-sided type. The trailers are pushed against the inside edge of the platform with which their body floors are level to prevent lifting, or they are run upon the platform on short ramps when the load of a wagon will fill one or more trailers. After being loaded to full capacity, the trailers are coupled together to form trains of five or six. This is done in the center of the floor in much the same manner as freight trains are made up in a switching yard. A tractor then pulls the train directly to the car float. As the train passes the doors of the freight cars, the trailers are uncoupled and their contents loaded into the cars by men who do nothing else. On the return trip, the tractor collects the empty trailers and hauls them back to the edge of the platform where they are again loaded in the same manner as before. Platform scales are placed along the edge of the platform to weigh each trailer load before it is taken down into the yard.

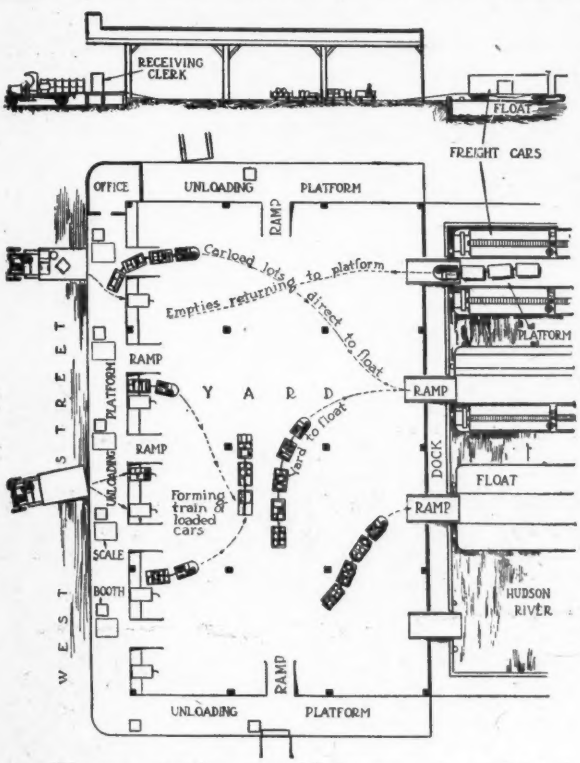


Diagram showing the arrangement for freight handling at Pier 4 of the Pennsylvania Railroad

The Terrific Strain of Trench Warfare at the Front

AFTER serving with the American Ambulance at the front, Dr. George W. Crile writes of trench warfare. "The nearer the trenches," says he, "the more desperate and intense is the fighting. ("A Mechanistic View of War and Peace," The Macmillan Company.)

"In trench fighting, both sides have adopted every variety of flame, acid, and explosive that ingenuity can devise. Every ruse, every stratagem, is employed in the close personal contact. It is as if one were contending all day and all night with a murderer in one's own house.

"In the first impact of war, many men in all of the armies became insane; many underwent nervous breakdown; some became hysterical; but the great majority became seasoned and maintained a state of good health. The rigid, alert, muscular response uses up much energy; the appetite is active, digestion good, and if the supply of food is adequate, the balance of nutrition is maintained. I have observed, however, that soldiers in the trenches show unusual lines of strain upon their faces, giving them the appearance of being from five to ten years older than their actual ages.

"While the proximity of the trenches has brought intensive fighting, it has also brought its counterpart,—fraternizing between the opposing sides. The men hear each other talk and sing, one side signals, the other answers, and their representatives appear and exchange food, tobacco, and newspapers."

In general, we may say that the warfare of the trenches represents an intense, though not necessarily a destructive activation of the system, which might be compared with the activation of prolonged athletic contests, or prolonged intense mental application, such as a chess contest, or the taking of difficult examinations. However, the first line fighters must be regularly and frequently relieved.

Doing the Albatross Amble

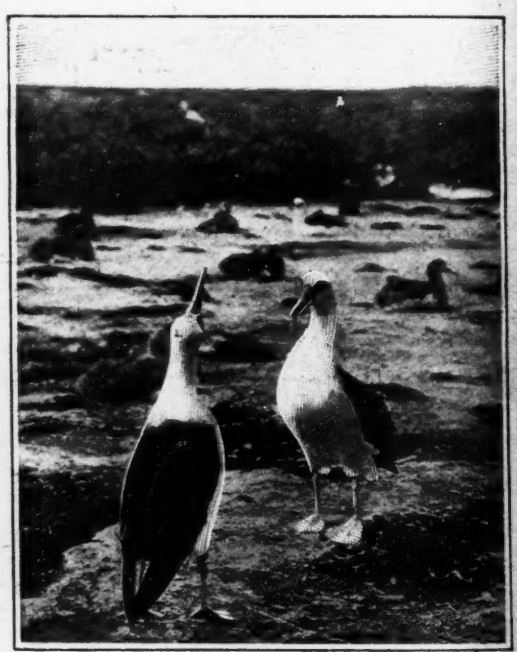
A new dance from the Hawaiian Islands that is unaccompanied by the ukulele

The albatrosses of the Island of Laysan, part of the "Paradise of the Pacific," may not be tame, but they refuse to be intimidated by trousers and hats

IN the middle of the Pacific Ocean about eight hundred miles west of San Francisco and a little north of Honolulu is a solitary isle about two square miles in area called Laysan. It is of coral origin. Its only inhabitants are millions upon millions of birds. More unusual still, however, is the fact that the most numerous of them, the albatrosses, have even developed little social customs of their own.

An albatross is a good deal like a farmyard duck, only bigger. Now a duck has no grace of form, being built a good deal like an underslung automobile—that is, set kind of low on the hind wheels. The bird is not cut out for sylph-like waltzing or other "light fantastic toe" stunts. But these Laysan albatrosses, duck-like waddlers though they are, manage to be real social lights.

The albatross in making formal calls approaches his neighbor, who sallies forth to meet him. The visitor struts forward with wings outspread in greeting. There is an exchange of courtesies. The host reaches around under his wing perhaps, as if to draw a cigar from his vest pocket and to proffer it to the visitor, much as a human being might do under similar circumstances. Visitor and host ceremoniously nod their heads and dip their stubbed tails in dignified unison. The visitor does a cakewalk around his host, spreading his massive wings and lifting his flat feet with all the fervor of an end man at a minstrel show. The host catches the enthusiasm and emits a series of spontaneous honks heavenward so that all the neighborhood may know the joy that reigns in his midst. After

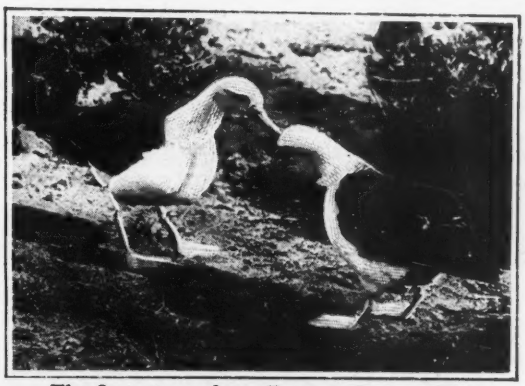


One bird is pouring his soul out in a solo—the other snaps its bill in vigorous response

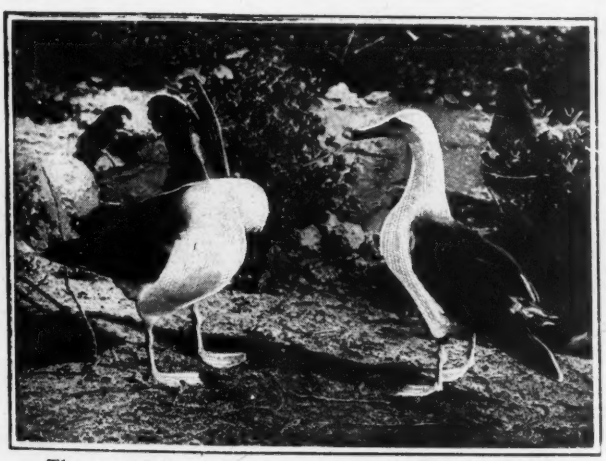
more cakewalking, in which both birds join, the reception winds up in a grand finale composed of more honk, more flapping of wings, and more strutting until the participants decide that the occasion has been properly polished off in a befitting manner. The visitor then ambles off, only to repeat the performance with the next feathered neighbor on his calling list. Why the birds go through this ceremony—thousands of them in different parts of the island at the same time and all the time—may only be conjectured. But birds living by themselves in this manner through countless centuries may easily develop strange customs all their own.

These birds are rendering a duet, uttering curious wails as our stars do in tragic, heart-rending opera

There are more than two thousand varieties of birds found on Laysan beside the albatross. One can hardly take a step without stepping on their eggs. The birds, not having been disturbed by man or other animals, know no fear and will come up to visitors in a nonchalant way.



The first stage of an albatross dance. The dancers have bowed and now rub their bills



The second step in the dance, wherein one bird bows, points its beak upward, puffs its breast and says, "Ah"

Does War Breed a Sense of Fear in Animals?

AN ENGLISH writer has made some interesting studies of the behavior of certain animals under war conditions. From him we learn that parrots were employed as sentinels at the Eiffel Tower in Paris, and could be relied upon to give warning of an approaching aircraft at least twenty minutes before it could be seen by the naked eye. These birds, however, grew "bored" after a while, and ceased to be dependable. Pheasants, too, were wont to give warning at night when an airplane approached, screaming and chattering noisily. It is also stated that hares, partridges and pheasants were often observed near the front-line trenches in search of food—which they got if the rats didn't see it first. It would seem that war has had no effect on them.

The top railing of the fence is ordinary piping with holes punched at intervals. The tank furnishes the water

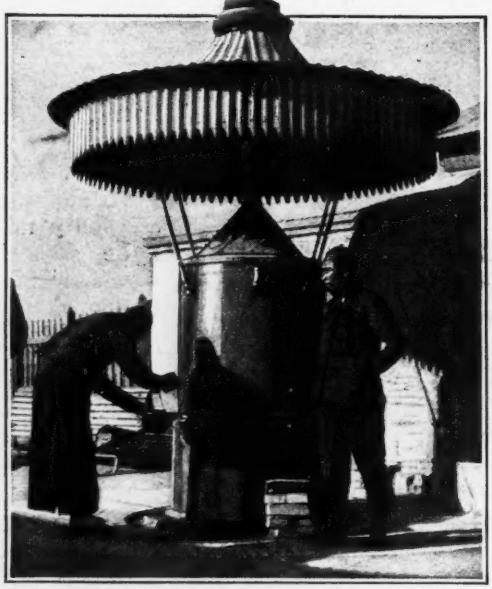
Using a Fence to Water the Lawn at a Railway Station

THE railroad officials at Mobridge, S. D., have installed a unique system for watering the station lawn. Since the fence railing is simply a pipe, it was decided to utilize it to carry the water. Holes were drilled at convenient intervals so that the water could spurt out. The holes have not been tapped in just the same position, so that the long line of sprays shoot out at different angles to cover the grass completely.

Making Tea at a Railway Station

IF you carry a teapot with you when you go on a railroad trip, you may experience some trouble in getting hot water when you want it—that is, if you travel in the United States. If you happen to be on the Mukden-Tientsin Railroad in China, however, you can get your boiling water at every stopping-place. Every station boasts one of the boilers shown in the accompanying illustration, and an attendant keeps the water boiling, so that the passenger, supplied with his own (or her own) teapot and oolong, can get off and fill up the pot and have a nice cup of fresh tea with the lunch or cakes that ought to go with it. The water tank is heated from below and is sheltered by an umbrella-shaped awning made of corrugated sheet iron.

It may be of interest to mention that the Chinese and their teapots are almost inseparable. They will not travel far without them.



Waiting for the 2.45 on a railway station in China means a cup of tea. Will the New York Central please copy?

Look Behind You While You Fly In an Airplane

THE old adage, "Look before you leap," may well be amended nowadays to read "Look behind you while you fly." In Europe the aviators are now as a rule equipped with "back-sight" mirrors on their airplanes, so that they can observe not only the approach of any machines that may close in upon them from behind, but also keep an eye on the passenger or aviation pupil seated behind them. It is frequently only a narrow margin that saves an aviator from a collision with an airplane approaching from the rear when making an abrupt turn, and on several occasions it may be desirable for him to observe what his companion is doing in the rear of the cockpit. Such a mirror serves both purposes.

If all aircraft from the beginning had been equipped with these "back-sight" mirrors any number of fatal accidents that have occurred might have been prevented.

© Newman Traveltalks and Brown and Dawson

An "at home" in the Arizona desert, enforced by the breaking down of one of the two Fords in which the party traveled. To camp out in the broiling sun is not all fun

Crossing the Arizona Desert in a Ford

THERE was a time when the crossing of the Arizona desert was an undertaking attended with tremendous risks. Many a prospector or ranchman who started on the hazardous journey, relying upon his trusty pony, was never heard from again. His bones are probably somewhere in that vast expanse, bleached by the merciless sun. Nowadays the desert is crossed frequently, and the best route is marked by a fairly well defined trail showing many wheel tracks, among them the tracks of light types of automobiles, principally Fords.

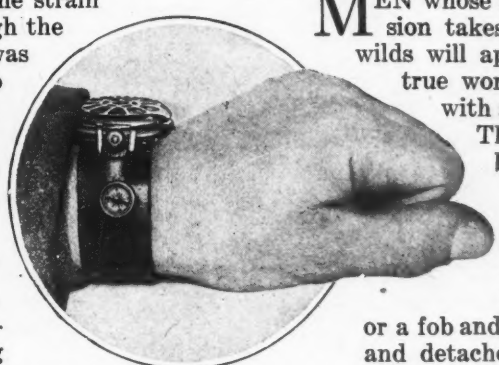
The illustration shows a party which came to a halt in the middle of the desert, because the rear wheel of one of their Fords broke down under the strain of plowing its way through the sand and gravel. There was nothing left except to make the other Ford light and to send it back to civilization for a new wheel. In the meantime the members of the party are camping out in the desert, an occupation which by no means could be construed into the proverbial picnic, for camping under a broiling sun is far from agreeable.

Acidity in Oil Lubricants Causes Wear of Metal

THE metal layers of an engine that come in contact with one another rub off small particles of matter that combine with the lubricant used and form a dirty and sticky mess. The olein contained in the lubricant will in course of time form an acid, known as oleic acid, which has a deleterious effect on the metal parts that it touches, causing progressive corrosion. But luckily, it is only when its oleic-acid content exceeds one-quarter of one per cent that an oil becomes unfit for lubricating purposes.

A Compass That Guides by Night as Well as by Day

MEN whose calling or diversion takes them into the wilds will appreciate at its true worth the compass with a luminous face. The compass can be secured to the wrist-watch strap of a soldier or hunter, an automobilist's gauntlet or a fob and can be attached and detached without difficulty. The luminous face makes it useful at night.



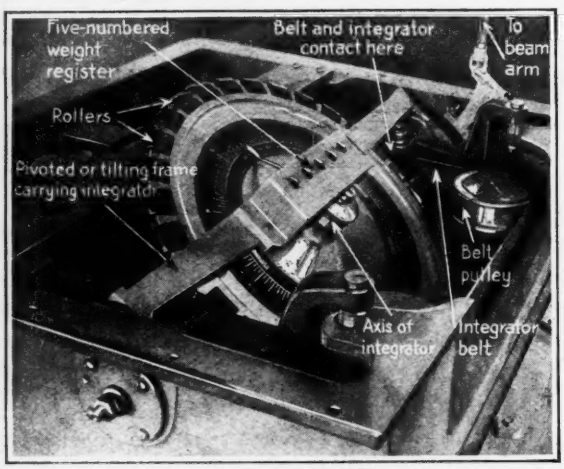
The luminous compass attached to a wrist-watch strap

Weighing Loads on the Run

In an endless stream, coke, coal, and cement pass on; yet every pound is weighed without a stop of the conveyor

AN automatic weighing device recently introduced by an Eastern manufacturer of scales solves in a clever and decidedly interesting manner the problem of weighing material like coal, coke, cement, crushed stone, etc., while it is carried on a belt conveyor and of making a record of the weight of the passing load, without stopping its flow.

Several of the troughing idlers which support the conveyor belt are placed upon suspension angles which hang from suspension rods. These rods, by knife-edged pivots, are connected with a system of levers, which, in turn are connected with the weighing beam. This beam is automatically brought to poise for different loads on the conveyor by a steel cylinder hanging from the beam and floating in mercury. As the loads vary the cylinder floats at different levels on the mercury, permitting the beam to tilt in proportion to the weight.

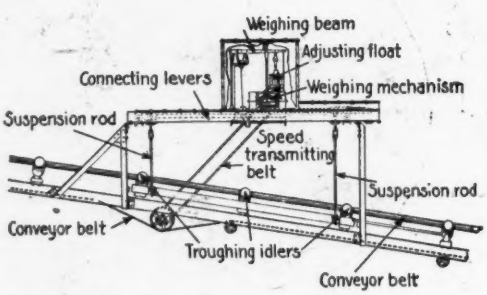


Every pound passing over the conveyor leaves its record in the tell-tale disk in automatic manner

A slender rod attached to the end of the weighing beam above connects it with the weight indicating mechanism. A frame supports this mechanism, a frame which is so pivoted that the changes in the position of the weighing beam are communicated to it by the connecting rod just mentioned, so as to tilt it a degree which depends on the deflections of the weighing beam.

Mounted across the bars of the tiltable frame is the shaft of the weight-indicating disk. While free to revolve between the bars, the disk is forced to tilt with the frame to which it is attached. In accordance with the weight on the conveyor this disk is tilted from the vertical to a varying degree.

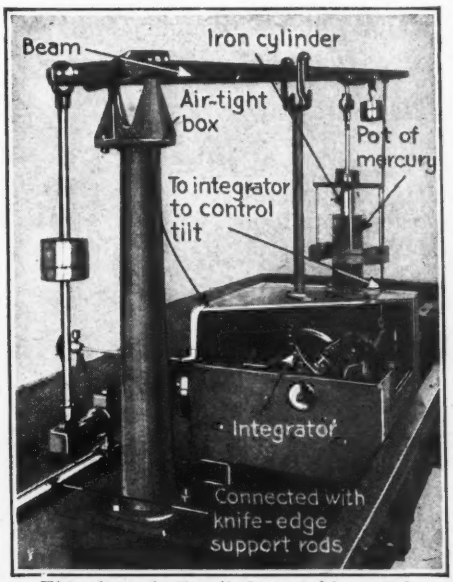
Into the edge of the disk, all around the periphery, small rollers are set, which come in contact with a narrow endless belt at two diametrically opposite points of the disk's periphery. This belt is driven in a horizontal circuit by a pulley deriving its power from the conveyor belt. When no load is on the conveyor and the disk correspondingly stands vertically, the narrow belt runs at right angles to the plane of the disk. As soon as the disk is tilted by the conveyor load, its position relatively to the driving belt, with which it is in contact, will change. Even a slight tilt will cause the belt to give to the disk a slow rotary motion, and the greater the tilt, the nearer the plane of the disk coincides with the plane of the belt circuit, the greater will be the speed of the disk. A five-figure counter operated by the end of



There is no guesswork about this mechanism; it's very similar to a cash register

the disk-shaft records the rotations of the disk. By correctly choosing the speed reduction between the conveyor and the narrow driving belt of the weighing mechanism, the counter will indicate weight in pounds, tons, kilos, or any other units.

This device, once installed and properly adjusted, does its work faithfully and correctly and requires but little attention. It means a large saving of time, labor and expense in all factories where bulk material which enters into the process of manufacture must be weighed while it is conveyed on a belt.



This shows in detail the weighing mechanism and its connection with the integrator which indicates the weight

Armor for the Shock Troops of the Modern Army

THE German army has provided armor for snipers, sentries and observers, the suit being designed chiefly for soldiers whose duties are stationary. The metal helmet is common to both the Allied and German armies.

A cuirass invented by Oscar Schaumann, a German, in 1908, attracted considerable attention. It has three plates, the first being of extremely hard steel and designed to break the points of the projectiles striking it. The second plate is composed of aluminum or duraluminum and the third of celluloid or horn. A softer substance, such as silk or asbestos, may be interposed between the plates and the cuirass proper to lessen the force of the bullets. The first plate, however, is designed to take away the momentum of the projectiles so that when they strike the cuirass proper it will be only slightly dented. Tests of the cuirass proved satisfactory.

A portable buckler fashioned after the ideas embodied in this cuirass is described as being studied by the Prussian Department of Artillery Technology. A plate of hard steel riveted to a plate of duraluminum constitutes the principal feature of the shield. Two leather bracelets fastened to the left forearm enable the infantryman to carry the shield. It does not interfere with the movements of the soldier and has considerable protective value. Reports of battles in Europe have not revealed the use of this buckler, however, this being due to the fact that all the available supply of duraluminum in Germany was needed for the building of Zeppelins. It has been pointed out that the buckler could be employed to great advantage in throwing bombs because it enables the soldier to have the free use of his hands.

The steel helmet worn by the soldiers in the European war has demonstrated its protective value unmistakably. Records of battles since September, 1915, show that it saved the lives of many men.

The helmet does not always stop bullets, but even when it is pierced it weakens the projectile's force so as to prevent serious injury.

He goes clanking like a junk wagon across No Man's Land

Developing a Fast Swimming Stroke

An engineer's swimming suggestions for increasing efficiency

By Marius Krarup, C. E.

THERE is room for engineering in the sports to revise faulty traditions and to hold the interest of those who demand more than physical exercise.

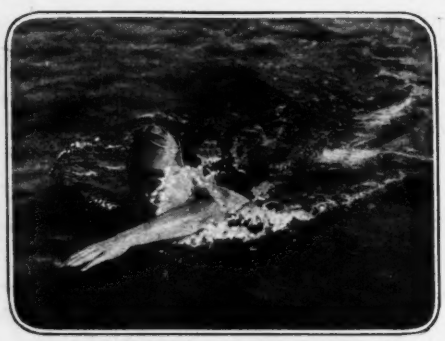
Most swimmers operate as a single-cylinder engine without a flywheel and therefore move in jerks. Yet they are equipped with four independent power elements—their hands and feet—and could, by practising, time their power strokes on the plan of a four-cylinder engine. Horses and dogs do so naturally but have not learned to make the idle strokes slow enough. The idle strokes have the body speed in addition to their own against them, and all expedients are valuable which (without too great special exertion) reduce the surface and the speed with which these idle strokes act against the water. The thighs, arms and shoulders are the chief sinners in creating resistance.

A complete cycle of movements comprises at least four power strokes and four idle strokes. The first one-fourth of the cycle may be the full-power stroke of the left arm plus one-third of the idle strokes of the three other limbs; the second fourth may be the power stroke of the right arm plus one-third of the idle strokes of the other limbs; and so on as indicated in diagram Fig. 1. Some of the leg strokes may be subdivided into quick jabs without interfering with this general plan for obtaining continuity of power application. If the duration of the cycle is two seconds, there is only one half a second each of the four power-strokes and 1½ seconds for each of the idle movements. By combining this timing schedule and by devising movements by which the idle strokes are made as harmless as possible—so that little is lost by making them too fast—it should be quite feasible to double the average degree of efficiency of the best swimmers.

Claire Gallegan of New York and Dorothy Burns of Los Angeles in a close race

The overhead, crawl, trudgeon and scissors strokes derive their superiority largely from complying with these requirements in some degree, but can probably be greatly improved when many swimmers begin to keep their minds on the right principle and strive to modify their movements accordingly.

The development of a stroke for fast swimming under water, where overhead action is inapplicable, should be interesting. The subject has several other complicated minor factors to be considered. The absence of a keel, or a dorsal fin, on the human body; the possible hydroplane action of the breast; the relative powers of the four limbs; the higher or lower "gearing" of the hand stroke according to



Every slight movement counts for or against your speed in swimming

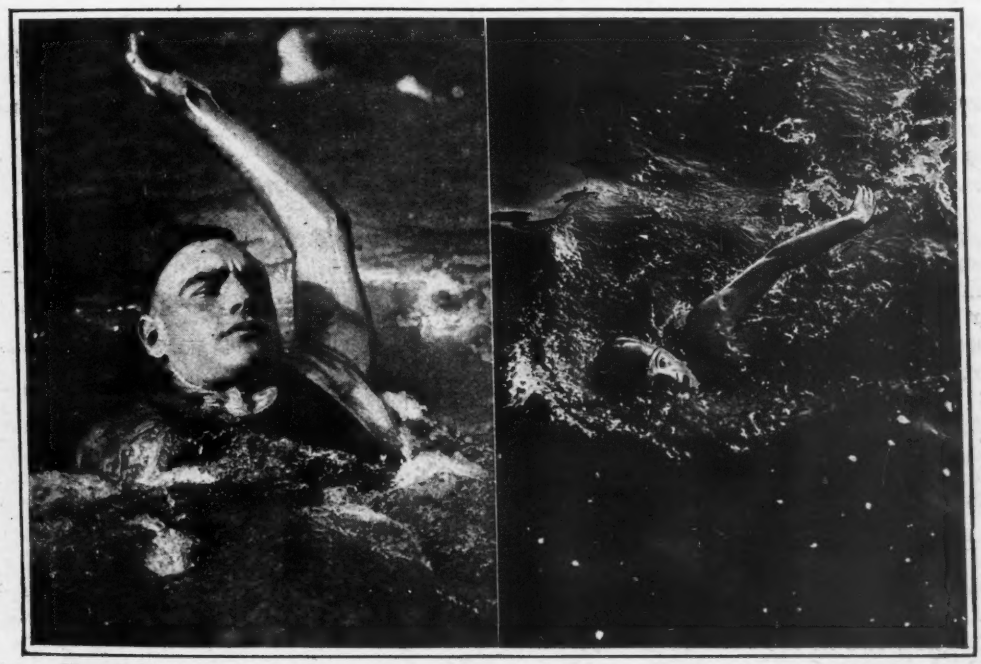
whether the arm is stretched or crooked. These must not be neglected. But they have an unmistakable way of asserting themselves, and can be passed by with bare mention here. The continuity of the propulsive movements, on the other hand, must be developed by deliberate self-training (some of which can be done on a mattress) and is of equal importance for a spurt stroke, a distance stroke and an under-water stroke. These three and at least one stroke for swimming on the back are waiting to be standardized.

The need of continuity is based on the fact that in water the resistance increases as the square of the speed. Steamers consume four times as much coal at doubled speed. Assume that one swimmer makes 90 yards in 60 seconds at an even speed, steadily overcoming a resistance which, for convenience in expression, may be designated as 10 pounds per second. The total exertion is then equal to 600 pounds. Another swimmer doubles the speed for 15 seconds, making half the distance against a resistance of 40 pounds per second. The total exertion is 600 pounds, or as much as the first man's for the whole distance. Whatever exertion he must make to cover the last 45 yards in 45 seconds, equalling the total time of the first man, represents his loss of efficiency. One yard per second is two-thirds of the first man's speed. The resistance to it is therefore $\frac{2}{3}$ squared multiplied by 10, or $4\frac{4}{9}$ pounds per second. For 45 seconds this makes just 200 pounds. His effort is increased 33 per cent through lack of continuity in the application of power. The result is the same whether he doubles the speed continuously for one-fourth of the time and then drops to two-third speed, from fatigue, or moves in jerks each of which has a speedy first half and a slow second half. The latter only is the commoner way of committing the error.

A Well That Is More Than a Mile Deep

A WELL being drilled on a farm in West Virginia in search of deeper oil sands penetrates into the bowels of the earth for 7,363 feet, or nearly one and one-third miles. It is hoped to find gas or oil under great pressure at a still lower level.

The depth of this well exceeds the height of Mt. Washington.



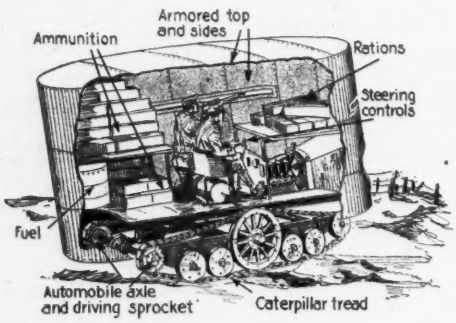
Here is Richard G. Dungan practising his backstroke preparatory to entering a race

Miss Marion Gibson just at the finish of a vigorous and hotly contested race

Ford's Artificial Armored Horse

The new two-man tank designed to take the place of cavalry

CAVALRY is almost as extinct as the Dodo or the Mammoth. The machine gun, barbed wire, shells that bury themselves twenty feet in the ground and then explode are responsible for the passing of the trooper. Horses cannot be used to advantage in shell-pitted territory and against a hail of machine gun bullets. No adequate method has been devised up to the present time to protect the horses against rifle and machine gun bullets, shell splinters and shrapnel. And so military men have had to invent an artificial armor-protected horse—the two-man tank, which is light, mobile, fast as a horse, and which wriggles in and out of shell craters with astonishing ease.



Ford's armor-protected tank has the caterpillar treads along the bottom only

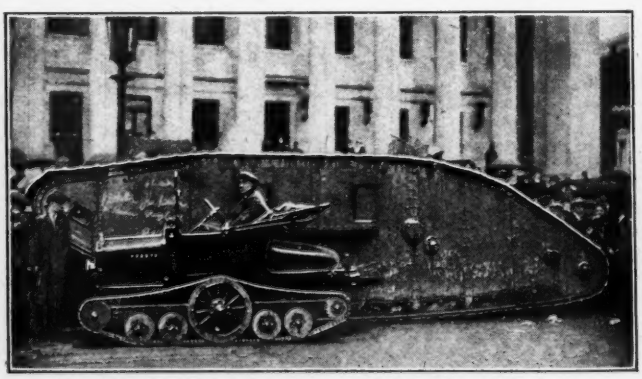
The two-man tank has been linked up with the name of Ford because it is proposed to use Ford engines to supply its power. It is the invention of C. H. Martin of Springfield, Mass., who has already constructed three of the units with the exception of the armor.

The first of the two-man tanks to be seen in public was shown recently in Springfield, Mass. In the accompanying picture it stands by the side of one of the British tanks. It is about one-half the length of the big tank and consists of a Ford power-plant mounted on a sub-frame. The driving sprocket is at the rear end, and on each side there is a big tread wheel in the center, with two smaller idlers in front and two in the rear.

The armor of this small tank weighs about 1200 pounds. At the present time no definite description can be given of the armor, but it is stated that each tank will carry two machine guns and will be able to travel at a speed of twelve miles an hour over fairly smooth ground and with half that speed over shell-scarred terrain.

It is claimed in favor of the small tanks that, because of their lesser weight they can go to places which the big tanks could not reach. It is also argued that a larger number of small tanks can do more damage than a smaller number of large tanks and at smaller expense. The armor of these two-man tanks is intended to deflect machine-gun-fire. Their speed will make it possible to use them in place of cavalry for quick dashes into the enemy's country.

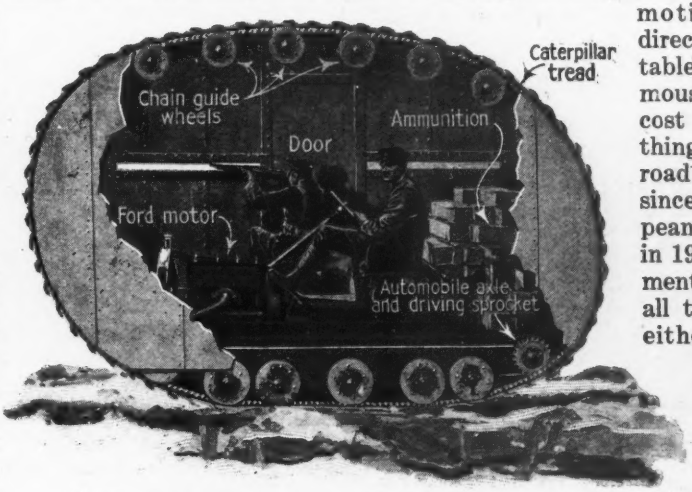
It has been rumored that these tanks will be more like giant wheels than the familiar elongated British tanks. Hence they may resemble the tank shown in the accompanying sketch, in which the caterpillar treads are run completely around the circumference of



The Ford mounted on a special chassis with caterpillar tread is standing by the side of a British tank which it surpasses in speed and mobility

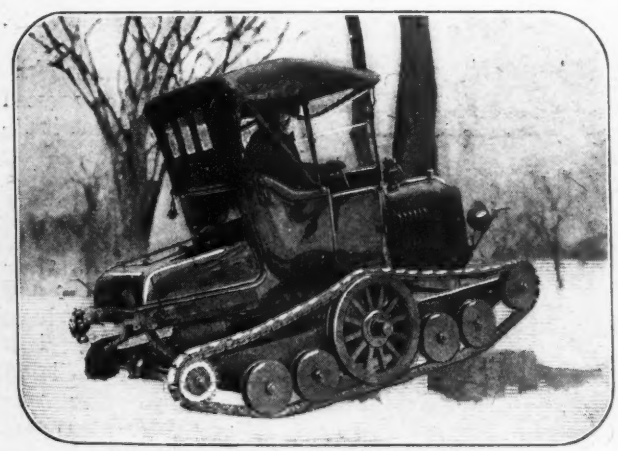
the wheel, the inner portion of the wheel being armored and remaining stationary.

Another possibility is that the new tanks will be patterned after the latest French tanks in which the caterpillar treads extend along the bottom only and are partly protected by the side armor. In that case the front and rear ends will be beveled to give the machine gunner and the operator a clear view for sighting their guns. In either case the tank will be steered by a modified Ford control to permit of stopping and starting either tread at will. If the French type of armoring is used, the tread could be arranged as shown in one of the pictures.



The Ford tank is more like a giant wheel with caterpillar treads around its entire circumference

The tank as a war machine is, like so many other new inventions, still in an experimental state. But it has proved itself so useful already that it will undoubtedly be made a part of the equipment of every army, although its structure may vary.



The creeper tread of the Ford easily surmounts obstructions that lie in its path

Cost of Railroad Equipment Has Gone Up the Last Four Years

THE transportation troubles of last winter—especially those which were due to shortage of freight cars and locomotives—were directly attributable to the enormous increase in cost of everything that a railroad needs, ever since the European War started in 1914. Equipment buyers of all the railroads either had to buy rolling stock and rails and repairs parts at from 50 per cent to 150 per cent increase over former rates or wait till prices dropped with the return of peace. For the most part, they preferred to maintain a "watchful waiting" policy; hence, the inevitable detriment to the service.

A good idea of the huge rise in prices of all railroad equipment may be derived from the following facts:

A serviceable box car that formerly sold for $1,200 cannot now be bought for less than $2,600, and locomotives have gone up from $30,000 to $60,000 apiece. Steel rails which in 1914 could be obtained for $31 per ton are now shipped at $46. The cost of passenger cars has risen in the same proportion.

It is little wonder that railroad managers bought sparingly during the last four years, even though their purchases are made on the installment plan. Uncertain about the future, they were afraid to mortgage the income of their properties. They put off the placing of their orders, hoping against hope that the war would end.

We never thought there was much music in a boiler-factory, but we're not so sure since the riveting machine is now part of Sousa's band

Stop Your Ears! The Band Is Playing the Boiler Makers' Fox-Trot

AN electric hammer that will imitate the sounds made in riveting during the construction of ships and boilers has been devised by Louis Paulero, of Petersburg, Va., for the use of bands in rendering a musical march composed especially for the ship-builders of the United States. The invention was designed particularly for reproducing the sounds made in a ship-building plant, but it can also be employed to imitate the reports of a machine gun. The hammer was provided for the United States Marine Band in response to a request from the United States Shipping Board.

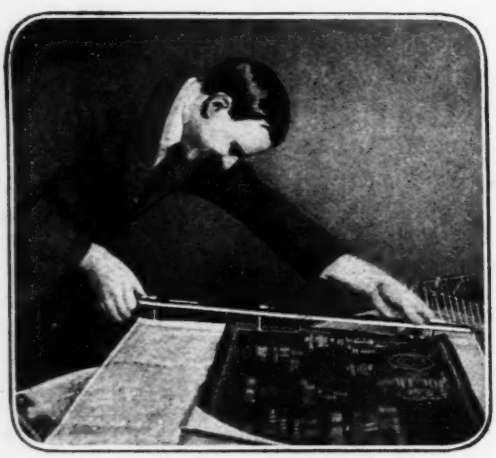
The instrument is mounted on a square steel plate, supported on springs over a wooden base. The drummer can operate the hammer by pressing a button either with one of his hands or feet in order to turn on an alternating current. The adjustment of a switch enables the device to be tuned so as to produce a tone that is high and shrill or one that is low and dull.

The new instrument was an ear-splitting success in Sousa's march, the "Volunteers," when it was first played in a concert given for the employees of the Shipping Board and the Emergency Fleet Corporation. The picture to the left shows that the electric hammer was played by the drummer of the band.

Making It Easy to Handle Large Blueprints

FILES or holders hitherto devised for blueprints are unsatisfactory. Their locking device is too insecure or too complicated to permit the quick handling of the prints .

A Boston manufacturer has now put an improved file on the market with an efficient locking device. The lower part of the holder contains studs or pins, which pass through the upper strip of the holder to which the locking device is attached. After the prints are in their proper position on the pins of the lower part of the binder, the top strip is put on and pushed down as far as it will go, by pressing on the curved end of a spring. The action of the spring exerts an upward pressure against the end of a tongue. This causes the edge of the oblique hole through which the hardened stud or filing pin passes to grip that pin firmly. To release the binder, the end of the tongue is pressed down so that it relinquishes its grip upon the stud. The top strip can then be lifted off.

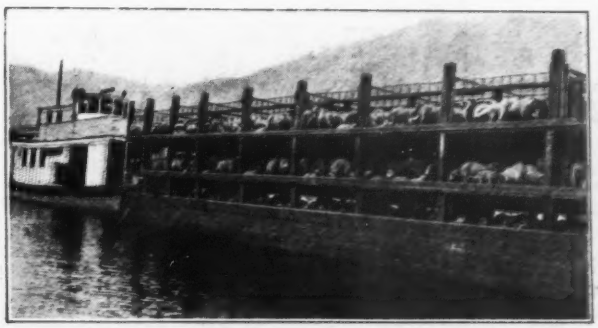


He has no trouble in handling the largest blueprints with a holder and a few pins

Architects, engineers, builders and draftsmen who have had trouble with their files will do well to give this one a trial. It will come up to all expectations.

Taking Sheep to Pasture on a Giant Excursion Boat

WAY out in Washington State lies Lake Chelan. Its head is accessible only by rough, narrow mountain trails or by boat or canoe from the lower end. At both upper and lower ends there is fine grazing country. But it was absolutely impracticable to take sheep over the trails, although it had often been tried. Then came along officers of the United States Forestry Service. They looked over the ground, saw its possibilities as a summer pasture, and said: "Well, why don't you take 'em up by boat then?"



These sheep are on their way to pasture on a triple-decked barge that carries two thousand of them each trip

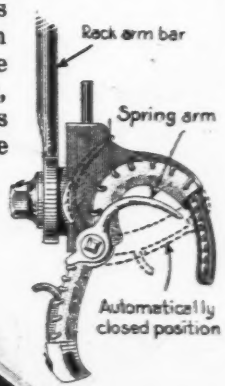
The outcome of this is the barge shown here—constructed like a New York scow, with three tiers of pens to accommodate the sheep. This barge is towed by a motor-boat.

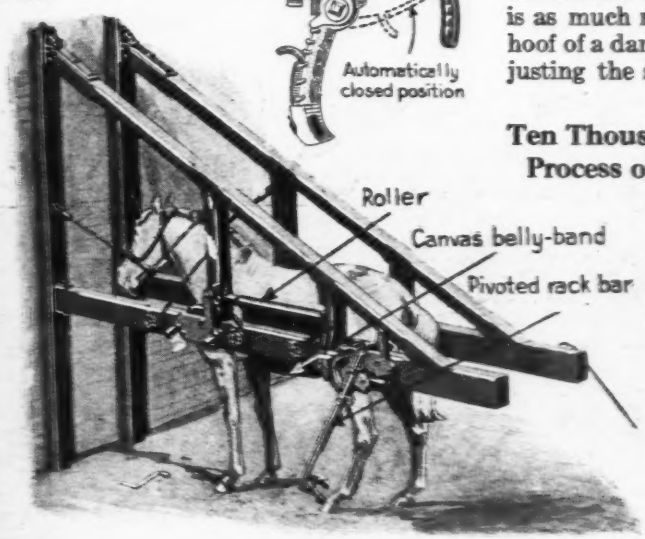
Still Another Apparatus for Holding Vicious Horses

IN the May issue of the POPULAR SCIENCE MONTHLY we published an article describing the apparatus constructed by the army farriers to counteract the evil designs of refractory horses. Here we have another contrivance, made for the same purpose, but of totally different design.

The main parts of this apparatus are two triangular heavy wood braces, hinged to the wall so that they may be folded flat when not in use. The horse is driven in between these and is just supported by a broad adjustable canvas bellyband.

For holding the horse's leg in position there is an arm which is movable to reach any of the four legs. It has a spring clip that grasps the hock, and the whole bar can be rotated or racked up and down, so that the hoof can be brought into the most convenient position. This mechanical feature is a great advantage, as there is as much risk in trying to pick up the hoof of a dangerous horse as there is in adjusting the shoe afterwards.





How can he kick while he is being shod?

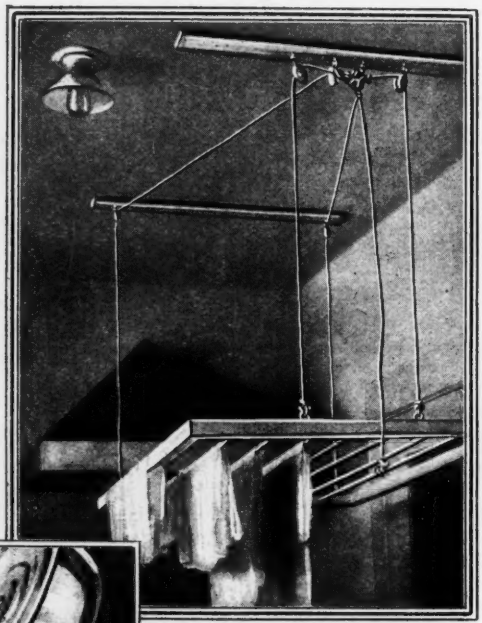
Ten Thousand Dollars Offered for a Process of Making Mixed Oil Fuel

THE British Government has decided to offer a prize of $10,000 for a process of making a mixture of dehydrated coal tar with mineral petroleum oils suitable for Admiralty use as fuel oil. This will be awarded to the first competitor submitting a successful process which must be capable of ready and economical application without undue absorption of material and labor.

Housekeeping Made Easy with

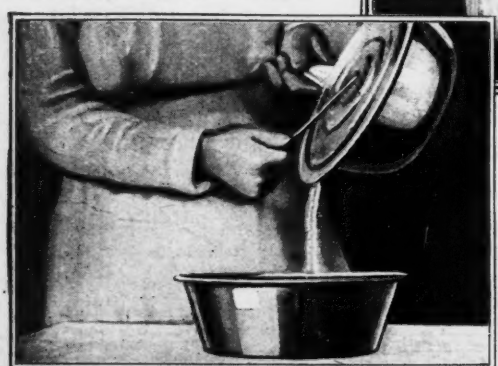
Humidifier with electric fan that will effectively and evenly distribute moisture in a room

Utensil cover with long handle made to turn right-side-up when laid on the table



Frame for hanging clothes is suspended from ceiling with ropes and pulleys

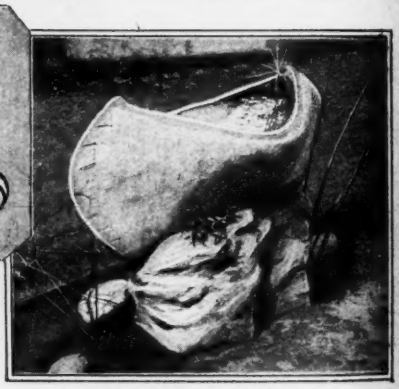
A three-in-one kitchen article—a step-ladder, stool and shoe-blacking outfit



A lady's parasol that when folded slips into the sheath-like handle

A sewing machine attachment which is driven by the belt to sharpen knives

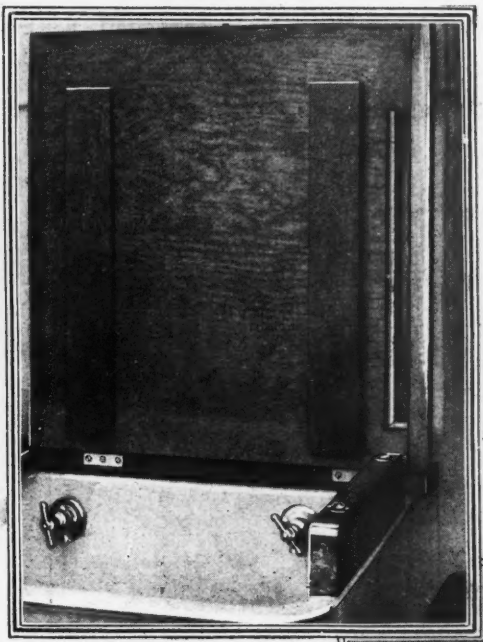
This doll is Jill—part of a quaint pair of Jack and Jill electric lights



Artistically arranged cement boat for the yard or garden

Mechanical and Electrical Devices

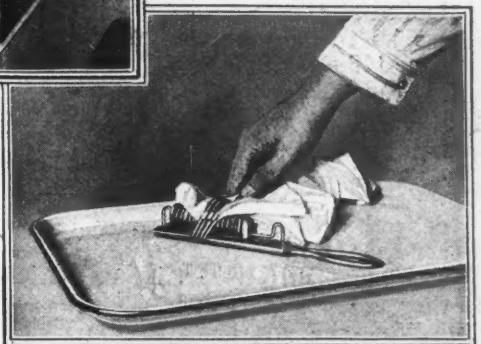
Long handle for the stoopless dust-pan

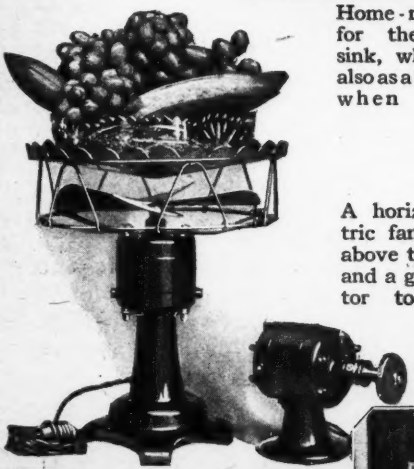


Home-made cover for the ordinary sink, which serves also as a bread board when let down

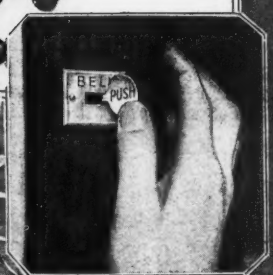
"U-say Uncle" statuette is used for a paper-weight

A coil of spring wire effective for cleaning forks with a cloth is shown below





A horizontal electric fan with tray above to hold fruit and a grinding motor to its right



A screen door catch which does duty as a bell-ringer when the door is fastened

An oxidized metal jar for holding twine is often useful and always ornamental

Cement flower pots with shapes like tree trunks for the garden

Flowers of Tin That Need Neither Water Nor Sun

FROM putting tin on roofs to making artificial flowers that rival Nature's own is a far cry. Yet that is exactly what has been done by Robert J. Nimmo, who is a sheet metal worker in the Department of Construction of the American Museum of Natural History.

One day Mr. Nimmo saw a flower shop which had such an engaging display of daffodils in the window that his attention was arrested. As he looked at the flowers he thought he would like to make some just like them. But how? Tin seemed pretty stiff material out of which to fashion so delicate a thing as a flower. Yet tin was a substance Mr. Nimmo felt he thoroughly understood.

The flowers that bloom in the spring may be nothing but painted tin

When he got back to the shop he kept thinking of flowers of tin. At his lunch hour he tried his hand at flower making. Daffodils were fresh in his mind; so he started on them. During his spare moments he worked at the daffodils. Finally they were done, pot and all. Then Mr. Nimmo borrowed some paint and colored the flowers and the pot. When the job was done the daffodils appeared so natural that a person would have to look twice before he realized that they were only artificial.

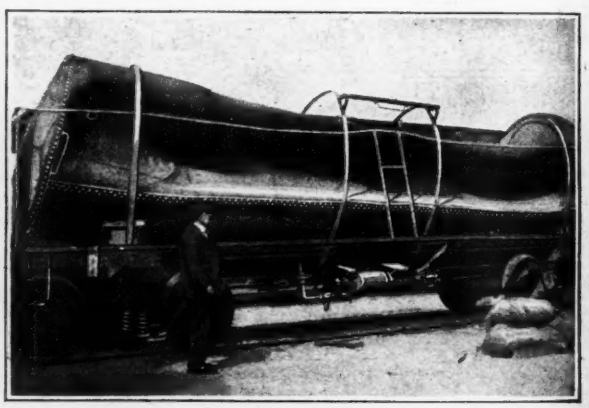
The Medium-Sized Oysters Make the Best Eating

MOST people are under the delusion that the largest oysters are the best. Mammoth oysters are served in good hotels and expensive restaurants at fancy prices, and the innocent consumer imagines that he has eaten something really choice. As a matter of fact, these bloated and pallid bivalves are poor eating. They cannot begin to compare with smaller oysters in respect to flavor or nutrient value.

Air (the Kind You Breathe) Pinched This Oil-Tank

EVEN a large steel oil-tank will not stand up against an atmospheric gas attack. Such a tank, with a capacity of eight thousand and eighty-five gallons, was being overhauled in San Francisco. It was planned to refill it with cocoanut oil; but first it was cleaned out by steam, a valve in the bottom being opened to permit the refuse to run out of the tank.

When the steam condensed a partial vacuum was created, which was enough to permit the atmospheric pressure (14.7 pounds to the square inch) to crush the sides of the tank as a large stone by its impact might damage a small tin can.

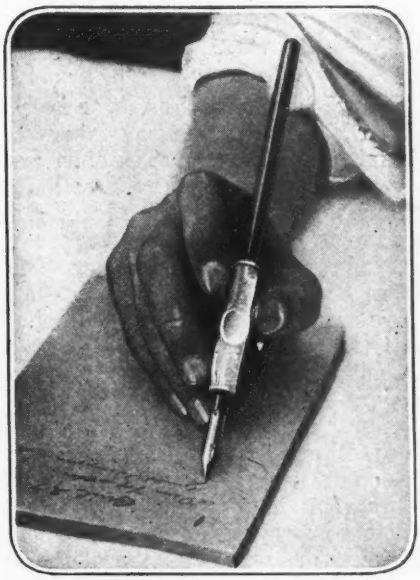


This is not a war relic. It is a steel oil tank crushed by the air—the kind you breathe

Bumps and Hollows That Teach a Child How to Write Correctly

A PEN-HOLDER which is designed to aid in correcting the faults of handwriting in school children is shown in the accompanying illustration. The device is made of hard rubber and can be slipped over the pen-holder proper.

Three lugs or enlargements on the device enable it to be gripped firmly by the thumb and first two fingers of the hand. These enlargements are spaced about an equal distance apart, permitting the pen to be held not only in a proper position for writing, but in such a position that the letters and figures are formed in the right way. Anthony Borsella of New York City is the inventor of the device.

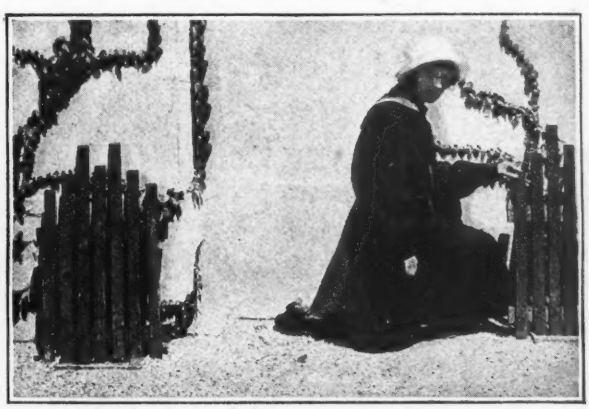


If we only had such a penholder when we first made "hen-scratches"!

Ornamental Lattice Protects Young Vines from Direct Rays of Sun

YOUNG Virginia Creepers and similar climbing vines must be protected from the direct rays of the sun until their growth is started and they become hardy enough to take care of themselves. Usually this is accomplished by hanging a piece of gunny sack, or some other unsightly thing in front of them.

Walter Reinhart of Los Angeles has devised a protection for young vines which is not at all offensive to the eye. Simple lattice shades are set in front of the vines until they grow sturdy enough to climb beyond the protecting shade. The lattices are made of laths stained a dark brown.



Lattices are used to shade porches. The same idea applies to young vines in the open

Planning a Diet for Weight Reduction

FUEL is the main food requirement of the body. A certain amount of fuel keeps the engines of the body working normally and produces energy. The surplus of fuel derived from the food forms layers of fat. So it is evident that the matter of keeping the body weight where you wish to have it is merely a matter of arithmetic.

Certain foods have an enormous fuel value in comparison with others. For instance, it would require nine dollars' worth of lettuce and tomato salad to furnish the amount of energy that thirty cents' worth of butter or ten cents' worth of sugar would supply. No one would think of feeding exclusively on any of these foods, but it is easy to see that the limitation of butter and sugar and the introduction of such foods as lettuce, tomatoes, celery, carrots, spinach and fruits, all of which have low fuel value, instead of fats, milk, cream and oil, pastry and sweets, would enormously reduce the fat-forming elements in the diet and yet fill the stomach and satisfy hunger.

The Canary Birds of War

How they save our soldiers from suffocation by succumbing to gas

By John Walker Harrington

THOUSANDS of canary heroines were called to do their bits in this war as gas scouts in mine, and sap, and grim replacement.

As these feathered auxiliaries, although native to the Madeiras, have been bred by myriads in the Hartz Mountains, the Germans can draft all they need. The Allies, however, who have used them most, have drawn upon the scantier supply at Norwich, England, and the surrounding towns. General Pershing issued a call for three thousand, and part of the levy was met in this country. Miss Mary Garden, the opera singer, commissioned Royal Dixon, the naturalist, to rear several hundred for service "Over There." And other Americans sent consignments.

Only the female canary is fitted for military purposes, for she, not being a songstress, is not likely to betray her presence. It is only by accident that the male of the species gets to the firing line. "Billy, of the Trenches" is a rare bird.

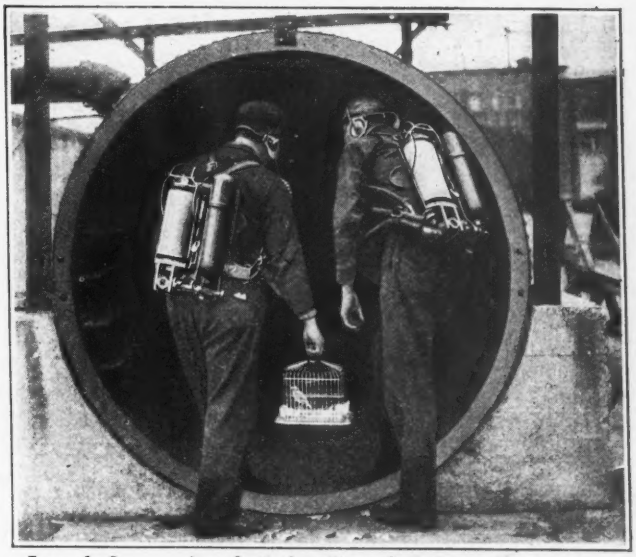
One of the pathetic incidents of the war is centred about such a feathered minstrel who in some way escaped from his cage in the depths of a military mine. He alighted on a bush in No Man's Land and forthwith swelled his throat in a burst of melody. His roundelay revealed an important operation to the enemy and orders were given to fire upon his refuge. He continued to sing, all unconscious of his death warrant, and it was not until the bush was blown up by a shell, that his blithe minstrelsy was stilled.

Some battle gases, deadly as they are, cannot be even smelled. But the canary drops over just the same

The chief war use of the canaries is for the detection of the dangerous gases which form in all kinds of confined spaces after heavy explosions. The small cages containing them will be found therefore in saps, in the galleries of military mines which are being driven under the enemy, in concealed, well-camouflaged machine-gun emplacements, and in deep pits where mortars and heavy artillery are hidden.

In this respect, the canary serves the same purpose as she has in the American mines for years, where small birds and animals had long been utilized for the detection of the deadly fire damps and the after damps, the carbon monoxide and carbon dioxide which have cost so many hundreds of lives in the collieries of the United States. In fact, the term "gassed" was used here long before it became a common expression of the European War. The effect of carbon monoxide is about the same upon the human heart as are the bromine and chlorine and other diabolical mixtures introduced by the Germans. Some of these compounds can scarcely be detected by smell, or sight, but the carbon vapors which follow explosions in closed spaces are always the invisible and insidious foes of man. To the presence of these the canary is peculiarly susceptible. Hundreds of the birds in the stores of fanciers have succumbed to coal gas from a stove.

George A. Burrell, of the United States Bureau of Mines, locked himself up several years ago with various winged creatures, in an air-tight chamber having a capacity of eighty cubic feet. He then had enough carbon monoxide turned into the compartment to make one quarter of one per cent. of the atmosphere enclosed. Within a minute the canary birds were in spasms and in three they dropped in a faint from their perches. Pigeons withstood the stifling atmosphere for eleven minutes. Chickens took no notice of it. The scientist was forced to get out after twenty minutes. He suffered for three days from a severe headache.



Long before a miner feels the effect of gas in a mine a canary bird suffocates. That's why canaries are used as gas-alarms

Miners when on rescues bent carry with them small cages containing canary birds. They also have masks and on their backs are tanks filled with compressed oxygen. They have ample warning of the presence of damp and can soon protect themselves when they see their winged monitors show signs of asphyxiation. The soldier must act more quickly with his gas mask. The earlier forms of this protector, such as the Germans used, could be adjusted in about twenty seconds. The new British type can be donned in three.

Just as in some galleries of a colliery there may be explosions which bring on the rush of the unseen afterdamps, so in the branches of military mines driven for the purpose of hoisting the foe skyward, the firing of heavy charges is likely to send the carbon gases back into the network of tunnels.

In the earlier stages of the art of choking one's foes to death by means of poison gases, stories frequently came to this country of the use of canaries for the detection of the approach of the banks of vapor, launched on the favoring breeze. As the gases were usually visible and traveled so quickly that they were overwhelming to those not masked against them, the use of canaries for work in the open was hardly practicable. Where heavy gases traveled slowly and gradually sank in ditches or open cuts or communication trenches, it would be possible for the canary, so sensitive that it succumbs to a mere trace of injurious fumes, to betray the presence of a diffused gas.

Courtesy of British War Mission

Canaries were drafted for service in the British army soon after the first gas cloud was launched

Soldiers often are apprised of the launching of a gas attack by the antics of small birds over the enemy lines. The lungs of a bird occupy a relatively larger space in the body than do the respiratory organs of most creatures, and although the canary is regarded as the most sensitive of the avine race to atmospheric pollution, other winged detectors have their value.

The military art develops over night, and the launching of gas attacks dependent upon the direction of the wind is giving way to the shell method. The gas shells are cylinders filled with compressed gas and provided with detonators which cause them to explode on impact. Such experts as Captain Noel Heaton, of the British War Mission, now in this country, testify to the extraordinary progress being made in the hurling of destructive vapors in containers from mortars. Soldiers these days have to keep their gas masks on most of the time during an engagement.

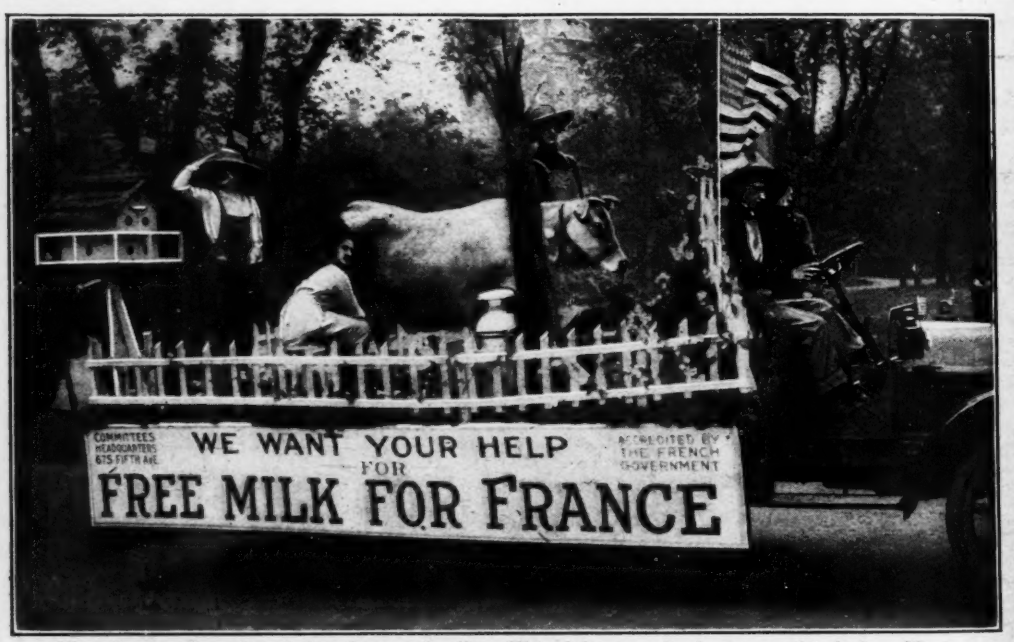
Fortunately the same science which invented the gas bombs also invented a a method of protecting the human organism against the injurious, often lethal effect of breathing these poisonous gases. The modern gas masks are efficient in nearly all cases.

Using Cottonseed Flour in the Foods of Man

ALTHOUGH the housewife may not be aware of the fact, it is likely that she is using cottonseed oil in some form as a food. This is due to the fact that it is contained in some of the novelties employed to replace fats longer known in cookery. Cottonseed flour, probably representing ground and bolted meal, is used to some extent in the foods of man.

Milking Cows on Floats to Raise Money for French Children

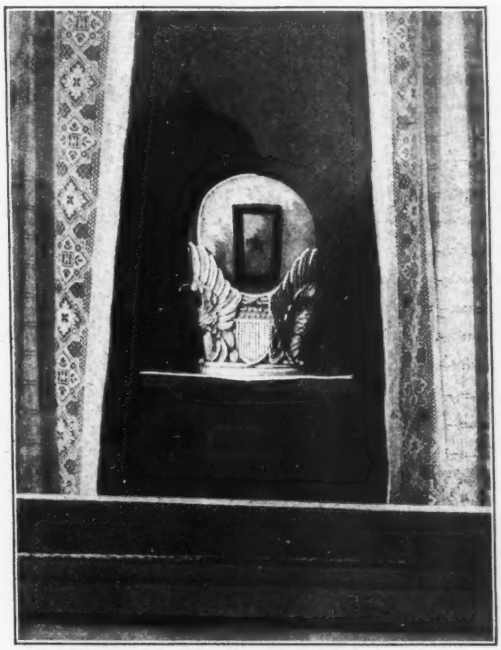
IN war times it takes the unusual to attract the attention of busy New Yorkers. But one day recently everybody on Fifth Avenue, Broadway and other crowded thoroughfares of New York paused to look in wonder when a number of floats carrying cows—real cows—and young women dressed as milkmaids appeared. The spectacle was a demonstration on the part of an organization formed to provide free milk for the children of France who have been deprived of it for a considerable time. As the floats passed along, the young women held out tin dippers into which pedestrians and persons in automobiles dropped coins.



Yes, the cow is real and she gives real milk. This dairy on wheels was used to induce New Yorkers to aid in supplying milk for French children who have long been deprived of it

The Guiding Lamp in the Window Displays a Service Star

THE honor light, designed to serve the same purpose as the service flag, has been devised to be placed in the window at night. The light has a handsome imitation bronze pedestal consisting of two decorative eagle models that support an alabaster flat ball, eight inches in diameter. The design of a service flag, applied by a waterproof process, appears on the face of the ball. Blue stars can be attached to the face of the ball, as required, to show the number of persons in the service. The device is twelve inches in height and can be illuminated either by electricity or wax candles.



The honor light can be placed in the window after dark to take the place of the service flag which flies by day

Delivering Mail on Tricycles in a Great Electrical Plant

THE delivery of the shop mail in a big electrical plant in East Pittsburgh, Pa., has always presented a difficult problem. There are seventy-six acres of floor space and several hundred departments to be served. The rapid delivery of papers, drawings, etc., is essential, especially in these days when the plant is working on Government orders, turning out engines for motors for ships and airplanes.

The old method of delivery by boys on foot proved inadequate long ago. For several years small electric trucks have been in use. But these trucks, satisfactory as far as mail distribution was concerned, proved to be uneconomical. They represented a considerable amount of invested capital and required the services of two grown men. They have now given place to a much less expensive but fully as efficient a system in which boys on tricycles are the feature.

These tricycles are similar to those ordinarily used by small merchants for delivering light packages. A metal box, fastened in front, contains twenty-two small compartments for papers and three large compartments for packages, rolls of blueprints, and other bulky parcels.

The tricycle solves the problem of mail delivery in large electrical plant

A Collapsible Boat for a Submarine's Use

A SHORT time ago a man was landed on the Irish coast from a German submarine. The man was arrested by British officers and the boat in which he had reached the coast was seized. It was a collapsible canvas boat, about eight feet long, two feet wide and twenty inches deep. Wooden slats formed the bottom. The sides lined with rubber, when inflated, greatly adds to the boat's buoyancy.

Building Imitation Alps of Rocks and

Every well regulated Alpine garden must have a rocking stone. This shows the carefully balanced imitation at Friar Park

This picture gives a good idea of the great size of the rocks used in making the Alpine garden. A total of 7000 tons was required

The picture in the center above shows the great rock representing the peak of Matterhorn just put in place on its foundation of chalk. This particular rock came from the top of the real Matterhorn. The rest came from Yorkshire

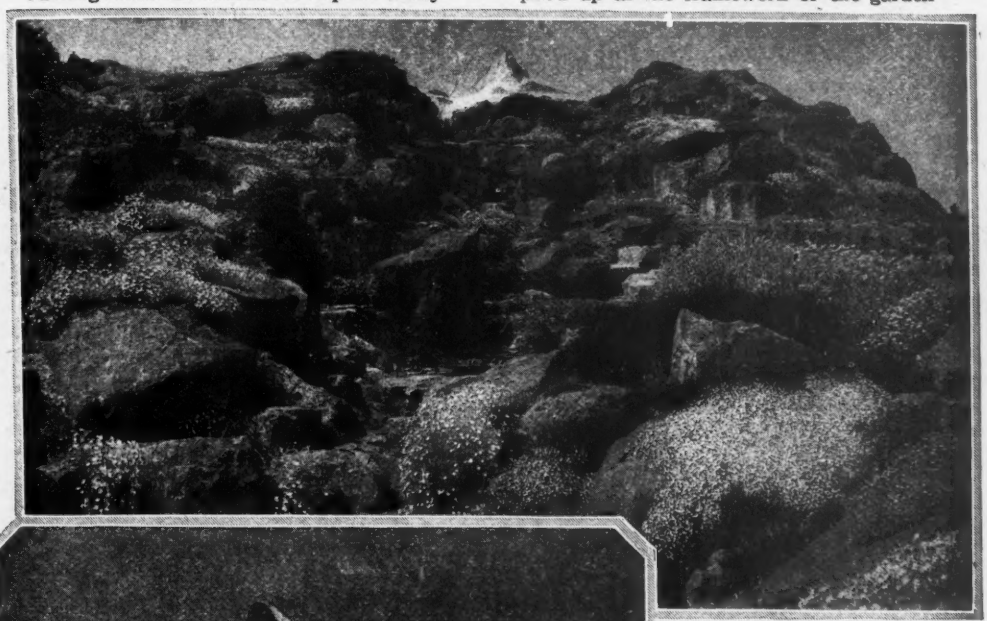
The trees which form the setting for the remarkable Alpine garden at Friar Park, Henley-on-Thames, England, created at great cost by the owner, Sir Frank Crisp, were transported by means of a specially constructed wagon shown below

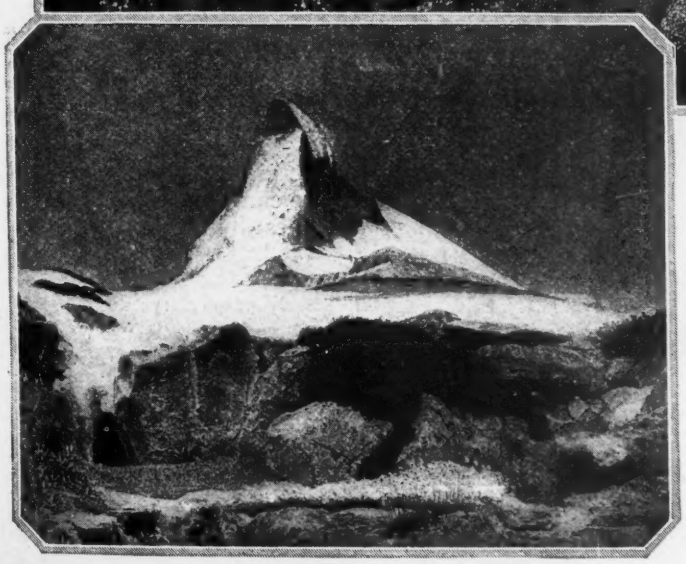
Under the artificial glacier is an equally artificial ice cave with counterfeit stalactites that look like icicles

Concrete on an English Nobleman's Estate

One of the rock basins fed by the torrents rushing down the miniature Alpine valley

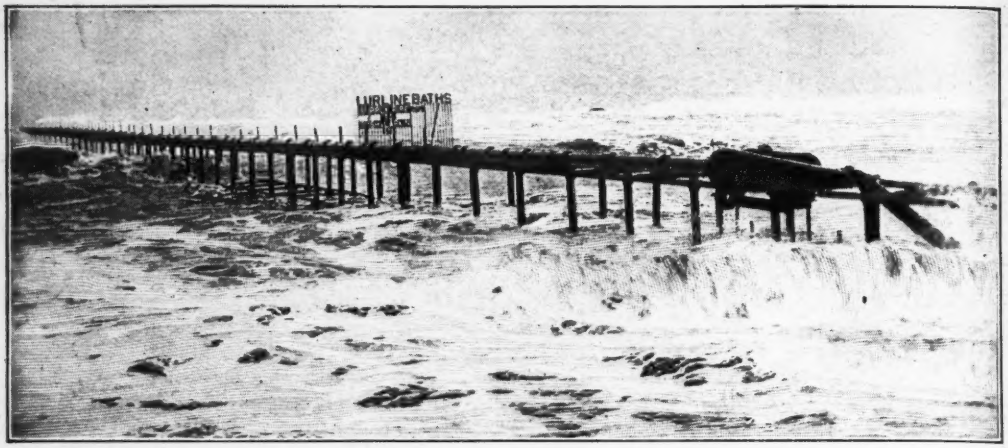
Giant blocks of rock, tons of them, were piled up as the framework of the garden





The general view of the Alpine scene, with the miniature copy of the Matterhorn in the background and the labyrinth of rocks, covered with gorgeous Alpine flowers, in the foreground, is charming

The snow and ice on the Matterhorn peak is imitated by pulverized Derbyshire spar. The Alpine flowers, profuse in the spring and summer, grow right up to the snow line



The intake of the six-miles long pipeline through which San Francisco obtains its bathing water is one thousand feet from the beach, where the water is deep and clear

How San Francisco Pumps Bathing Water from Pacific

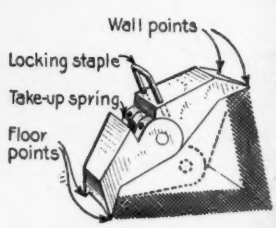
SAN FRANCISCO uses vast quantities of salt water in scores of her large public bathing establishments. To conduct this water from the Pacific into the city a powerful steel bridge has been erected, which extends outward from the beach to a distance of one thousand feet. On this a huge iron main is laid. Some distance inland is a pumping station. The water is conveyed by a pipe line, about six miles long, into the heart of the city, from which point it is distributed.

A Brace to Bar Your Door to Burglars

A DEVICE for securely fastening a door opening inwards in case the lock should be out of order or as an additional protection against intruders was invented recently by Dr. Harry B. Roberts. It consists of two metal parts hinged together to form a knee joint. At the free end each of the two parts has a sharp edge with two prongs. When the brace is to be used, it is placed against the lower rail of the firmly closed door so that the prongs of the other end rest on the floor and the knee joint buckles outward, away from the door. Then the middle part is pushed toward the door, until the knee is completely straightened. By this straightening the span is lengthened and the prongs are pressed deeper and more securely into the wood of the door and the floor. To prevent the knee from buckling, a staple is provided, which firmly locks the two hinged parts when the knee is fully extended, similar to the manner in which the lock pin fastens a pulley to the shaft. A spring between the hinged ends of the brace maintains the pressure of the ends of the brace against door and floor. This makes it impossible to loosen the brace by shaking the door.

The only possible objection to the device that we can see is the unsightly holes it makes in the wood.

Pushing down the knee joint straightens the brace and pushing down the staple, locks it



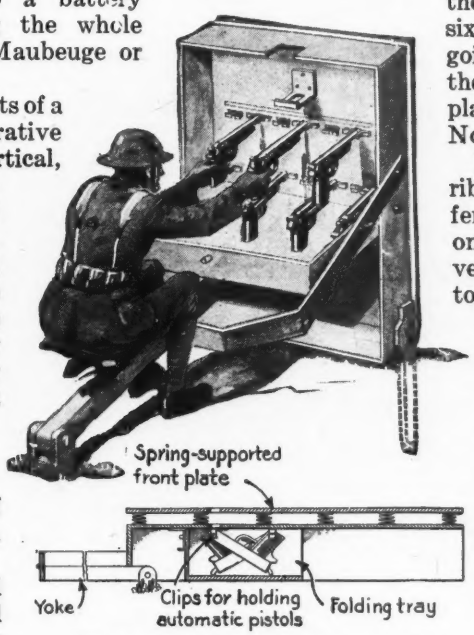
A Miniature Fort for Every Soldier

He can carry it with him when he goes out to lick the Germans

A MAN down in the well-known city of Myrtle, Miss., has evolved a truly beautiful modification of the many portable breastworks and bullet stoppers, in that he has added to this laudable effort, also a battery of revolvers, making the whole merely a miniature Maubeuge or Namur.

The invention consists of a steel plate that in operative position, stands vertical, staunchly facing the foe. This plate and also the decoy plate in front of it are pierced with port-holes for the revolvers which are mounted in battery behind it. The decoy plate, located a short distance ahead of the main plate, is backed by coil springs. This is one of the important points. What happens?

Sit back and hold tight while we tell you that the springs back of the front or decoy plate are compressed by the blow of the bullet fired by incautious Hans or Fritz, whereupon the recoil of the springs hurls back plate and bullet, promptly smiting said Hans or Fritz on the rebound, with his own bullet!



The upper picture shows the portable fort in use. Below is a diagram showing its ingenious construction

With the breast-work raised to its vertical position, covering two soldiers, there appear, swinging from their clips, with their muzzles pointing grimly through the port-holes as the carronades of Bainbridge pointed through the sides of the old "Constitution," six revolvers, which the inventor says are "preferably of the automatic type." He doesn't know that automatic revolvers outside of a freak type built years ago in England, are largely figments of the inaccurate newspaper man's imagination, automatic pistols being more generally used. Still this inventor specifies automatic revolvers, and we let him have his way.

Let an incautious Teuton dare to stick so much as a finger from his shelter, and the two soldiers start the six automatic revolvers going, something like the Swiss Bell Ringers playing The Chimes of Normandy.

If, in spite of this terrible instrument of defense, the foe still insists on coming over, the inventor has arranged it to fold down flat on the ground, the revolvers pivoting to lie out of the way, and the whole covered up by the then prone decoy plate. The inventor calls attention to the fact that in this position it is not in the way of retreating troops. What would they be doing out ahead of such a fort? Echo does not answer.

The device is said to be light and easily carried. Imagine any one lugging a little steel fort that can resist mauser bullets!

The inventor says that these portable breastworks are really intended for use during a retreat. The troops can stop at any point, erect these breastworks and open fire on the enemy by means of the revolvers. Alas! he does not state what happens if the enemy unfairly stops 300 yards away, beyond which pistols are not accurate. He fails to mention one very great advantage of his shield, during a retreat. Here it is: So long as the troops continue to carry them there will be no danger of their breaking into a run and turning the retreat into a rout.

Surrender Quickly When You Face This Armored Car

"HOLD up your hands and cry 'Kamerad,' or I'll shoot!" cries a boyish voice, as you approach the house. Coming down the path you see a miniature armored car, moving rapidly toward you. The only occupant, a little boy in military uniform, tries to look his fiercest as he looks at you from behind the formidable machine-gun which is pointed threateningly at you.

Some day this kiddie may operate a "sure enough" armored car against the enemies of his country

Perhaps you hesitated a trifle too long in obeying the command—the little soldier's hand gives a turn to the gun-crank in front of him and with a vicious "Ra-ta-ta-ta" the gun begins to spit imaginary bullets in your direction.

The little boy is glowing with excitement and pleasure. He has vanquished the enemy who refused to surrender and with a joyful "Hurrah!" he runs his armored car to the other side of the house in quest of other enemies.

The armored car shown in the picture is mounted on a tricycle frame and carries a big gun in front and a few smaller guns on each side. A spring snapping over cogs produces a noise like that of a machine-gun, when the crank is turned. Toys of a martial character are always extremely popular with boys and the great war, naturally, has increased the interest of the kiddies.

And the Mountains Arose and Cried "57 Varieties!"

AS one travels through the countryside of Southern California, impressed with the grandeur of the scenery and marveling at the wonderful sweeps of mountain and valley, a number looms up like a nightmare on a distant hillside—a familiar and dread number that recalls stifling street-cars and crowded subways. t glares white on the side of a distant mountain. At night the haunting number stands out in ghostly radiance on a ground of velvety black.

What are we vaporing about? Merely the magical well advertised Number "57." It has been sunk in immense concrete figures on a California mountain side. A battery of electric lamps illuminate it at night. This immense sign can be seen ten miles away. There are "57's" throughout Southern California, and they tell their story at all times but still are blotches upon the landscape.

Do you see that dot on the "5"? It's a man. And the frame between the "5" and the "7"? That supports a battery of lamps to light up the numerals and so make night hideous

Fifty-Seven Ways of Sleeping in This Mechanically Adjustable Bed

PERHAPS it isn't poor digestion that makes you spend sleepless nights tossing about on your bed; it may be that all you require are new positions for your head and feet. In that event the bed shown in the accompanying illustrations will fulfill the requirements, for the operation of its mechanism will place the sleeper in fifty-seven different positions.

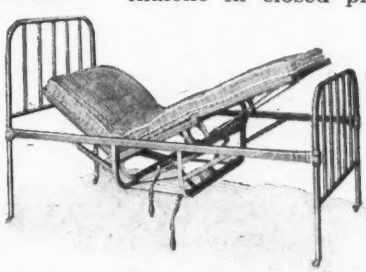
Giving patient a comfortable position by simply turning the crank

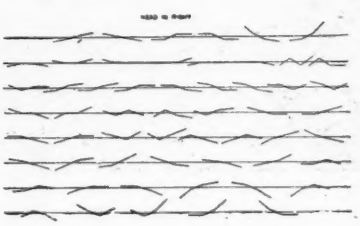
It was designed primarily for hospital use and for the comfort of convalescents in the home, but is manifestly well adapted for Sunday lounging also. Its advocates point out that it will induce sleep in the weary when the straight-back bed has failed to do so.

The multi-position bed is constructed like an ordinary bed, except that its springs are on three panels which can be moved up and down and adjusted to various angles by cranks. These cranks can be turned by the occupant of the bed unassisted. As soon as the crank stops moving, the panels which it governs are locked in the position desired. These panels can be moved until they touch the floor or are placed in vertical positions.

The operating mechanism is of simple construction, containing no ratchets, latches or insecure fastenings and the frame is doubly trussed.

It will occur to many that this mechanism can be readily adapted to surgical uses. The surgeon's operating table, as we know it, does not allow changes of position. This device will more than satisfy requirements anywhere it is installed.



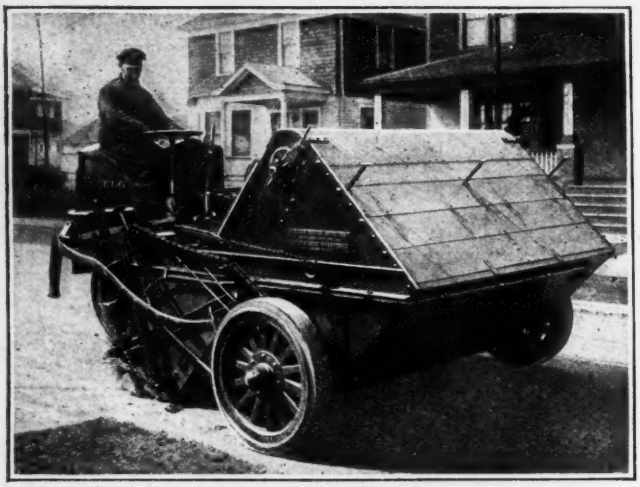


Above: one of the positions which may be given to the bed. Below: a diagram showing the fifty-seven different positions possible

There's Little Hope of Conquering the Clothes Moths

DR. RALPH C. BENEDICT, an eminent chemist and student of entomology, about four years ago undertook a careful and systematic study of the clothes moths with the aim of solving the problem of moth-proofing ordinary woolen fabrics. Dr. Benedict accumulated a mass of the most interesting information concerning the life and activity of the various clothes moths during the various stages of their development and made numerous experiments to ascertain the effect of many poisonous substances on the eggs, the larvae and the mature moths.

In the resumé of his researches which Dr. Benedict published recently he holds out little hope of conquering the winged pests which cause so much damage to furs and woolen materials. He finds that remedies intended for the flying-moth stage are worse than useless. So-called repellants, such as tobacco and cedar, did not repel or harm the moth in any stage. The same may be said of other strongly odoriferous substances. Kerosene and gasoline fumes were not effective. Camphor and naphthalene in closed places kill all stages. The eggs and larvae turn from whitish to a yellowish brown in color and the larvae cease their activity almost immediately. Strange to say, the larvae lived for weeks on cloth soaked in corrosive sublimate without showing any discomfort. It does not take more than a grain of the stuff to kill the strongest man.



First it sprinkles the street, then it sweeps, and finally it gathers the dirt up and carts it away—all mechanically

It Wets, Sweeps and Carries the Dirt Away. One Man Runs It.

A MACHINE that is able to do the work of four horse-drawn sweepers, and clean the streets at a cost of only seven cents per thousand feet is shown in the accompanying illustration. This machine is equipped with an eighty-gallon water tank, under a sixty-pound pressure, which is located at front and which sends the water onto the pavement through four nozzles. Thus the dust is wetted before the eight-foot brush at the rear end gathers it in. A conveyor carries the sweepings to a large box in front, which has the capacity of two ordinary wagons.

The power is supplied by a forty-horse-power engine in the rear, and connected with this is an air-pump which produces pressure for the water tank. A chain-and-sprocket arrangement revolves brush and conveyor.

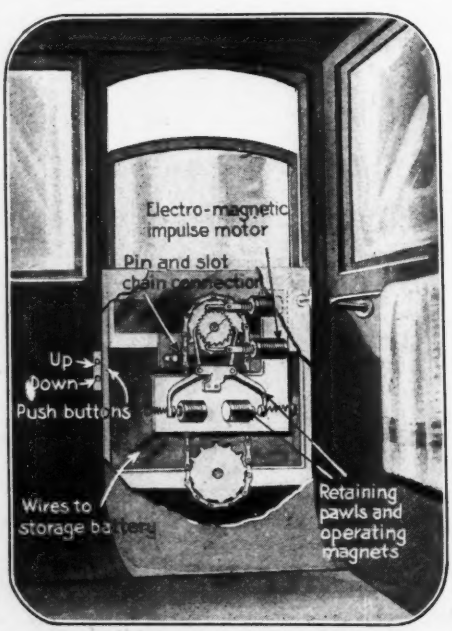
Warm? Push a Button and the Window Opens

IMAGINE yourself leaning back against the swelling cushions of your luxuriously equipped limousine. It was cool when you started and the windows of the car were closed. But now it is warm, uncomfortably warm, and you long for a breath of fresh air.

What was it that the genial demonstrator for the automobile concern said about opening and closing the windows? — "To open the window, press on button No. 1 and keep your finger on the button until the window is down as far as desired. To close the window press on button No. 2 and continue the pressure until the window is raised to the desired point."

You press the button. The window opens and you bless the inventor of the mechanism, Harry Emery Norwood, of New York.

The entire apparatus is concealed between the panels of the carriage or automobile door. A chain running over two sprocket wheels, one right beneath the window, the other lower down, raises or lowers the window. It may move in either direction and is connected with the lower part of the window frame by a stud. The upper sprocket wheel is attached to two ratchet wheels, the teeth of which are arranged in opposite directions. Pawls, actuated by electro-magnets, act upon one or the other of these ratchet wheels, when an electric circuit is established by



If you want to open or close the window, push the button!

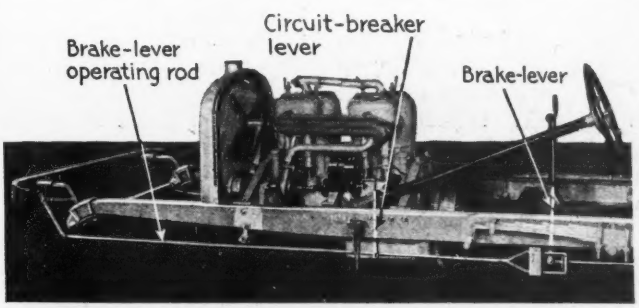
the pressing down of the corresponding button and impart to that wheel a step by step revolving motion. This motion is communicated to the sprocket wheel and through this to the chain. As the chain moves in one or the other direction, the stud, by which it is connected with the window frame, will raise or lower the window, as the case may be. Two locking pawls, operated by another set of electro-magnets, normally lock the two ratchet wheels, thus preventing any change in the window's position.

For Excitable Car Drivers

THE man in an automobile who hits a pedestrian usually loses his head. He becomes so excited that he fails to apply his brakes or shut off the engine. In addition to being knocked down the pedestrian is run over. Clifford W. Cole of Camden, N. J., comes to the poor pedestrian's rescue with a type of fender which automatically applies the brakes and shuts off the engine when the fender strikes.

In congested traffic like this drivers are apt to lose their heads and injure others

An ordinary fender mounted on springs is carried on two brackets on the spring horns. A small bar, near one end of the bumper, is fulcrumed on one bracket and has its lower end connected with a horizontal rod extending longitudinally under the car frame to the brake lever where it is fitted with a yoke that operates the brake lever, so that the brakes are applied when the rod is given a forward motion as the bumper strikes. In the middle of the rod, a pivoted vertical circuit-breaker is attached and provided with a contact at its upper end. As the rod moves forward to apply the brakes, the contact is pulled away from its seat on the spark plug wires leading from the magneto to the cylinders and the circuit thereby broken, stopping the engine immediately.



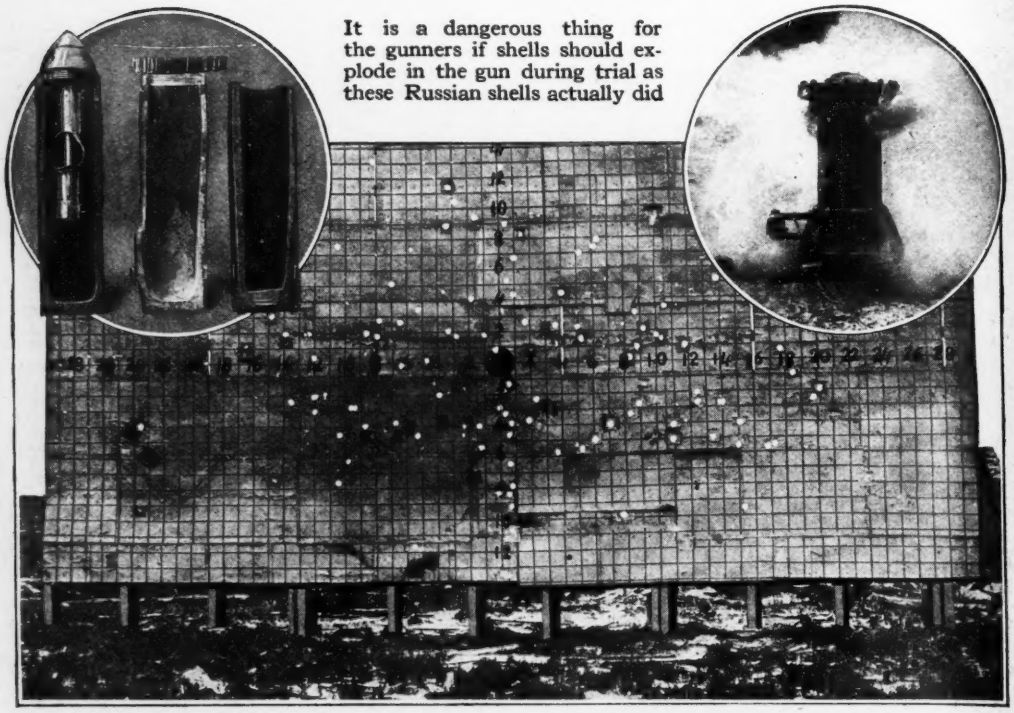
When the fender strikes something it stops the engine and hence the car—so that it can't run over anybody

Gasoline as Dangerous as Dynamite

MANY automobile owners do not fully realize the danger connected with the careless handling of gasoline. In a general way they recognize the explosive power of the liquid, but few of them know how great that explosive power is. A writer in one of the magazines devoted to the automobile trade seeks to make this clear and more impressive by comparing the explosive power of gasoline with that of dynamite. He points to the fact that gasoline, even at low temperature, constantly develops an explosive vapor. Five gallons of gasoline will generate 8,000 cubic feet of gas, which, if ignited, expands 4,000 times. One gallon of gasoline, properly mixed with air and compressed, is equal to about 83 pounds of dynamite in explosive force. What makes gasoline particularly dangerous is the fact that it is more rapidly ignited and exploded than dynamite. One can never be too careful in handling gasoline under any and all circumstances.

Exploding "Duds" by Electricity

Shells which have failed to explode are fired by electric sparks to find out their defects



It is a dangerous thing for the gunners if shells should explode in the gun during trial as these Russian shells actually did

In the circle on the right is shown how unexploded shells are exploded in a bursting pit on the Eddystone Range, Lakehurst, N. J.

Forty out of forty-two shots fired from a field gun hit this target at the Eddystone Range at seven thousand feet distance

DO you know what "duds" are? In the military slang which has developed during the great war a "dud" means a shell which shirked its duty by refusing to explode. Many of these shells are picked up after every artillery attack, and they constitute a source of danger, because they sometimes explode unexpectedly while they are handled.

When ammunition is tested on the proving grounds of the Eddystone Range at Lakehurst, N. J., the shells which fail to explode are carefully collected by "shell-scouts" and brought to the testing pit for defective shells. The "duds" are exploded by an electric spark in a steel pit provided for that purpose. By this method the experts are able to determine which particular feature of the shell was defective.

Before the shell is fired, the small door at the bottom of the pit is opened. The shrapnel and other contents of the shell are hurled through the door by the explosion. This relieves the pit of a considerable part of the force of the explosion, and prevents the ultimate congestion of the pit.

Sometimes the shells burst in the gun during the firing tests and it has happened many times that the gun was destroyed by the explosion. One of the pictures shows some of the Russian shells which exploded in the gun during the test. Another picture shows a target in the proving grounds which was used to try out Russian shells and guns at a range of 7000 feet.

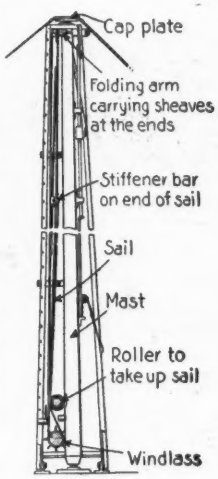
The distances at which the shells tested were timed to explode were 7000 feet, 10,500 feet, 14,000 feet and 17,500 feet, The records were made by photographing the shells as they exploded.

The Labor-Saving Sail-Raiser

A sail-raising device that lightens the labor of the crews of wind-jammers

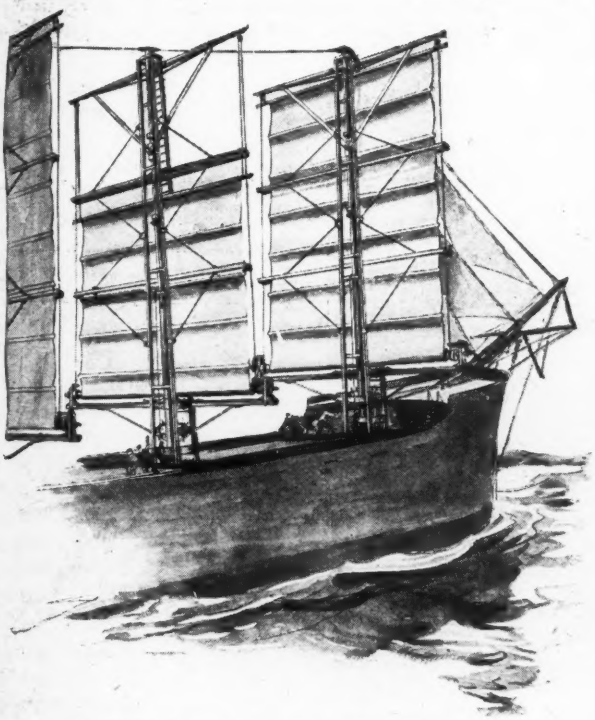
IT was in 1862, when rounding Cape Hatteras in an army transport, that E. W. Brown, then a soldier in the Union army, realized the hardships of a sailor in raising and lowering sails in stormy weather. Although now in his seventy-eighth year, he has only recently patented a sail-raising and lowering device by which he expects to reduce the crew of a sailing ship from four to twelve men. The device is particularly designed for square-rigged ships.

A ladder-like structure or tower is fastened to the mast or masts. Each mast is pivoted with its lower end on a pin, immovably secured to the deck by means of a bolted plate.



The upper end of the mast is pivoted in a plate which is held in position by guy ropes or cables. The entire structure is revolvable on the pivot and may be stayed in any position by bolting the side pieces of the ladder to brackets of which a number are fastened to the deck in suitable places around the pivoted mast. This arrangement makes it possible to set the sails at right angles to the direction of the wind and to hold them in that position at will.

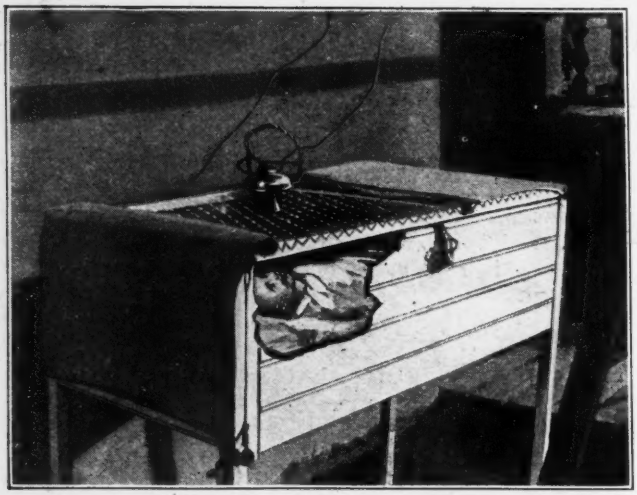
The sail, when not in use, is wound around a roller at the base of the tower. It can be hoisted or lowered by a cable running over a pulley near the top of the mast and worked by a windlass. To keep the canvas of the sail taut guide cables are provided which are attached to the ends of the top yard of the sail, run over pulleys at the end of the top cross-arm of the tower and back to the sail roller. The cable is there wound around a conical drum which tightens the cable as the sail is let out. If so desired, the top yard of the tower may be folded against the mast by means of a toggle joint.



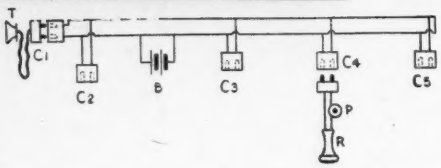
A distinctive feature of this device is the ladder-like tower that is fastened to the mast

Huns Drop Bombs That Light Up the Landscape

GERMAN aviators in recent raids on Paris used a device like a rocket, with a clock movement. The bomb on exploding releases a linen parachute equipped with a cartridge containing a substance with a magnesium base. This is lighted automatically about 1000 feet above the ground and casts a strong light over objects below it for two minutes.



When the baby in its crib on the roof is crying, the mother can hear it in the telephone. The diagram shows the wiring. Note the transmitter fastened near the baby



How Crying Babies Summon Their Mothers by Telephone

MANY modern city apartments have no yards, and even if they had, it is a long way down from the upper stories. How is the baby to get the several hours a day out of doors so necessary to health?

I solved the problem for myself by building a crib on the roof. But the baby's mother, anxious as all mothers are, was impelled to run up on the roof about every five minutes to see whether baby was crying.

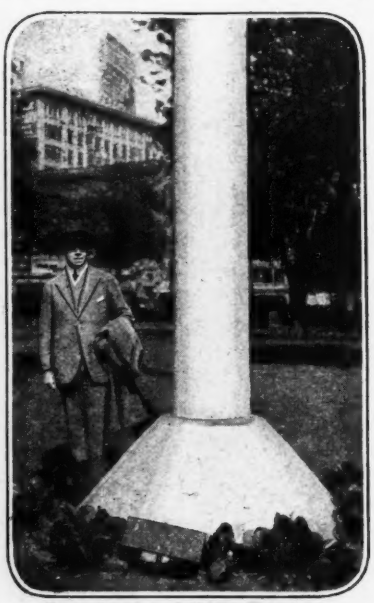
To obviate these frequent trips to the roof I rigged up a telephone system between baby's crib and the apartment. A standard transmitter was fastened on some wire netting stretched over the head of the crib and a receiver placed down stairs in the apartment. The two were connected with bell wire and operated on two dry cells. In order to save the batteries a push-button was located in the circuit by the receiver.

Now all that mother has to do is push the button and listen in the receiver to hear whether baby is crying.

A piece of flexible twin conductor is used at the transmitter, terminating in an ordinary plug connector so that the transmitter can be easily removed in stormy weather or at other times when not in use.

The device proved so effective that it has been extended to other apartments in the building occupied by friends. When mother goes visiting she puts the transmitter at the baby's crib, takes the receiver with her and plugs it in at her friend's apartment.

On Saturday nights several of the families in the building get together for cards, when all their babies are put in one apartment containing the transmitter.



It only cost $32 to construct a concrete base for this flagstaff in a Los Angeles Park

Ingenuity and Concrete Save a Flagpole

WHEN a one hundred and ten foot flagpole in Central Park, Los Angeles, became wobbly, a resourceful city engineer reset it in concrete. Props were set around the pole to hold it securely while workmen excavated to a depth of four feet around its base. In the bottom of the excavation a ring of ten-foot piles were driven around the bottom of the staff. Then concrete was poured in and moulded around the pole as shown in the picture. The concrete cone rests on the piles.

Thirsty? Take a Drink from the Fern Ball in the Garden

EARTHEN jars sufficiently porous to keep their surfaces moist, and thus cool the contents by evaporation, are commonly used in Mexico and throughout the southwestern sections of the United States. These jars are known as ollas.

By wrapping such a jar with floral moss to a depth of five inches, binding it in place with copper wire, and covering the moss with growing maiden-hair ferns, Herbert C. Goudge, prominent Los Angeles lawyer, has secured a most beautiful as well as useful article for the adornment of his Japanese garden. The walls of the jar are just porous enough to keep the ferns fresh and the water at a delightful temperature for drinking. This water will not yield in coolness to that of the "Old Oaken Bucket." It only requires a poet's pen to make it popular. Moreover, the cost of the completed ornament is trivial when compared with its beauty and utility. The capacity of the jar is five gallons. In the picture below the young lady has just dipped a cooling draft from the jar, which nestles in a mass of ferns.

Porous earthen jar, covered with moss and ferns, supplies cool drinking water

"Island of Safety" in Chicago where Garfield Boulevard and S. Michigan Ave. intersect

Proper illumination would have prevented this untoward accident

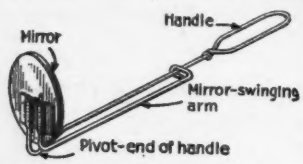
Unsafe "Safety Islands" and How to Make Them Safe

PARADOXICAL as it may seem, there are such things as unsafe islands of safety, those little havens of refuge for the pedestrian who has to cross a busy street and finds himself hemmed in by the criss-cross traffic. The "unsafety" of these "islands" lies in the circumstance that many of them are not properly lighted at night, and the motorist, confused by the glare from his own headlights, is liable to run into them. One of the accompanying illustrations shows just such an accident. The other picture, showing an intersection of two residential streets in Chicago, demonstrates how such islands of safety can be made more serviceable by surmounting them with strong arc-lights. A still better method is suggested, namely, that of having the post or pillar surmounted by a red globe, below which is a cluster of white lights that throw a powerful illumination on the base of the "island." With such a light to warn him no autoist will have any excuse for running into the pillar.

Looking at the Other Side of Things with a Mirror

PIPES, pipes, and some more pipes; long and short, straight and crooked pipes; they run in every direction and form a perfect maze between the condensing tanks and boilers.

Two men, one the superintendent of the plant, the other, judging from his appearance, some kind of mechanic, have picked their way through this jungle of pipes in the dim light filtering through the distant basement windows. They have reached a point near one of the big up-



You Can Make One for Yourself

A light and small mirror with a tin back is hinged to a wire handle of desired length. Another wire, provided with a sliding loop, so that it may be moved back and forth along the handle of the mirror, is also hinged to the back of the mirror. By manipulating this wire, the mirror may be swung around its axis to any desired angle

right condensers, but are barred from further progress by the network of pipes.

"The trouble must be right back there," says the superintendent, "but I don't see how you'll ever be able to find out what is the matter, unless we take down all these pipes."

Without saying a word, the other man takes two objects out of his tool bag. One of the objects, in the form of a tube, proves to be an electric torch, the other consists of a double wire handle with a small bright disk set at right angle to the wire, attached to the bent end.

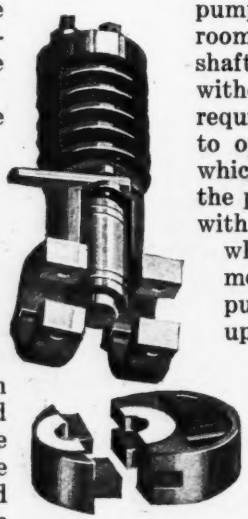
Holding the torch with his left hand, the man reaches with his arm between the pipes and turns the powerful light of the torch upon the rear side of the condenser. With his right hand he manipulates the wire handle in such a manner that in the mirror at the other end he can see the part in the rear of the condenser which the torch effectively illuminates. In a few minutes he has located the trouble and ascertained its cause. It is then easy to apply the remedy.

You Can Blow Up Germans or Grow Vegetables with Nitrogen

NITROGEN enters as a vital element in the making of various explosives, and without it many destructive articles could not be manufactured. On the other hand, nitrogen is indispensable to man's chief source of food supply—namely, plant life. In the form of ammonia, this gas is applied to the soil as a chief ingredient in fertilizers.

Compact Air Pump for Your Launch

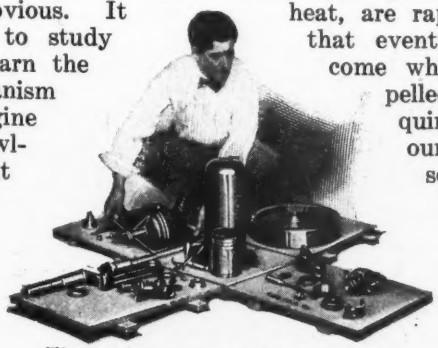
OWNERS of gasoline launches or other power boats may be interested in an unusually clever air pump which has recently been placed in the market. The pump is compact, takes very little room, is worked by the propeller shaft to which it may be attached without taking out the shaft and requires no appreciable extra power to operate it. An eccentric cam, which is split, fits tightly around the propeller shaft, so as to engage with the piston of the air pump which is fitted to the shaft by means of hinged journals. The pump will fill a ten-gallon tank up to sixty pounds pressure in about ten minutes if the propeller makes 450 revolutions a minute. A pump of this kind is extremely useful for pumping air with which to work the whistle or to draw the bilge water which gets into the launch through leaking seams.



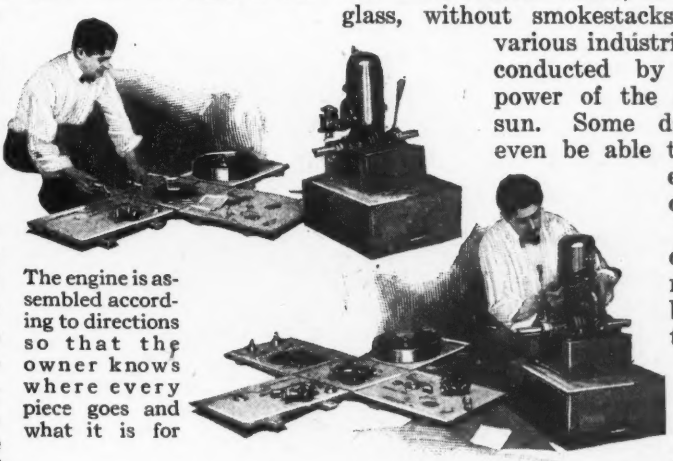
No extra power needed to run this air pump

Get Acquainted with Your Engine by Setting It Up Yourself

THE advantage of putting together his own engine, after a man has bought it, is obvious. It gives him the chance to study its construction and learn the part each piece of mechanism performs when the engine is in operation—knowledge invaluable when it comes to cleaning it or making adjustments and necessary repairs from time to time. The manufacturers of a certain kind of engine, principally intended for motorboats, have adopted a novel and taking method of familiarizing purchasers of their engines with their mechanism and at the same time reducing the cost as a special attraction. They ship the parts of the engine, carefully numbered and securely fastened in a folding box, which, after being opened, can be laid out flat on the floor. Following closely the printed directions, the purchaser of the engine detaches one part after the other from the supporting boards of the box and puts them together in the manner prescribed. The various parts are machined to snap-gage accuracy. If set up in accordance with the printed directions the engine will be found to be in perfect order. By assembling and mounting the various parts of the mechanism the owner becomes thoroughly familiar with it and with its working, and he also has the satisfaction of having saved a considerable percentage of the price. In case it fails to work he can have the fault remedied at once.



The engine reaches the buyer with its parts fastened in a folding box and carefully labeled and numbered



The engine is assembled according to directions so that the owner knows where every piece goes and what it is for

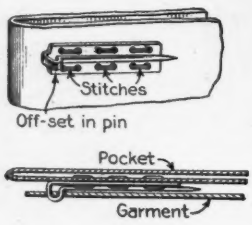
Will the Sahara Furnish Power When Coal Gives Out?

IN view of the fact that coal and wood, the principal sources of artificial heat, are rapidly diminishing and that eventually the time must come when we shall be compelled to derive the heat required in our homes and our industries from other sources, a discussion of the possibility of finding such new sources is of intense interest. Professor Giacomo Ciamician of Bologna, an eminent Italian chemist, in an address before the Eighth International Congress of Applied Chemistry pointed out that in six hours the sun would deliver in energy taken direct from its rays the daily power value of 2,500 tons of coal on every square mile of desert land. In the United States about six hundred million tons of coal are mined annually. The desert of Sahara alone receives every day in solar energy the equivalent of six billion tons of coal. He stated that great progress had been made already toward the utilization of direct sun power. He prophesied that in time tropical countries would be thickly populated and that on their arid lands would spring up great industrial centers where, in buildings of glass, without smokestacks or smoke, various industries would be conducted by the direct power of the rays of the sun. Some day we may even be able to get along entirely without coal.

When that day arrives it may not even be necessary to dig for coal or to worry about the supply or price of it. The sun will supply the world directly with heat and power for all purposes.

This Pocket Can Be Attached Almost Anywhere You Please

FOR the convenience of campers and soldiers in the trenches a detachable pocket has been put on the market that can be fastened to a horse-blanket, or the inside of a coat, or, in fact, anywhere that is convenient. The pocket is complete in itself and is fastened to the desired piece of cloth by four metal clips that penetrate the cloth and are bent over to hold it in place. The free ends are tucked back so that they will not stick in anything.



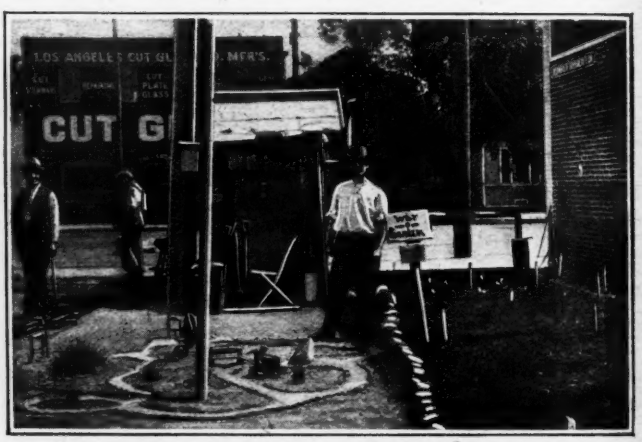
A pocket when and where you want it

At the Tail End of the Earth's Glacial Period

DR. Marsden Manson of San Francisco, an eminent authority on geology, points to the fact established by recent antarctic explorations, that the great ice cap covering the region of the South Pole is shrinking. From this he draws the conclusion, that the gradual subsidence of the Age of Ice, of which the polar ice caps are the existing remnants, is still going on and that we live, so to speak, at the tail end of the glacial period. He expresses the conviction that the same succession of geological climates has prevailed in antarctic as in other latitudes and says that the evidence collected in recent antarctic explorations is corroborated by the comparatively recent uncovering of temperate land areas, and the progressive retreat of the snow line to higher elevations in temperate and tropical latitudes and toward the poles at sea level. He comes to the conclusion that the disappearance of the Ice Age is an active present process and must be accounted for by activities and energies now at work. He considers it as proved that the rates and lines of retreat are and have been determined by exposure to solar energy and the temperatures established thereby; and by the difference in the specific heat of the land and water hemispheres.

A Switchman Is a "War Gardener" When He Is Not on Duty

THAT a man can be a switchman and a "war gardener" too has been demonstrated by George J. Budman of Los Angeles. He was anxious to start a "war garden," but as he lived in an apartment he could not have one at home. However, he did not give up the idea and at the crossing where he is stationed—one of the most dangerous in Los Angeles—he found a plot of ground about twelve feet in width and twenty feet in length, which was close to the switchman's working quarters. This he turned into a "war garden." He is now successfully growing a number of vegetables, and is happy in the knowledge that he is "doing his bit."



It was only a twelve by twenty plot of ground, but George J. Budman made a war garden of it when he wasn't switching trains or watching the crossing

Converting Garbage into Chicken Feed

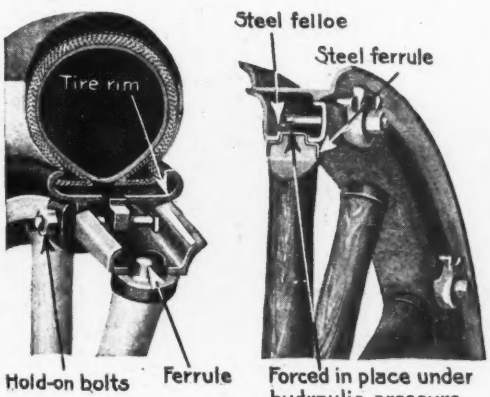
MR. WILLIAM H. FAUST, of Los Angeles, has recently patented a process for converting garbage into poultry food. The garbage is sorted, and wood, tins and other inedible articles removed, together with the large bones. The remainder is then cooked with steam for about four hours at well above the boiling-point of water. The large bones are ground up and mixed with the rest in the cooker. Then superheated steam is turned into a steam-jacket which surrounds the cooker for ten or fifteen minutes to sterilize the contents, after which they are thoroughly dried. In this condition they are put in a grinder and coarsely ground. The resulting foodstuff is laid in windrows to absorb moisture from the air, and is then ready to feed to poultry and live-stock. When this stuff is mixed with bran or middlings a well-balanced ration is the result.

Under ordinary water pressure the spray will thoroughly cleanse the vegetables

This shows another practical form of the device for washing vegetables

Steel Instead of Wood for the Felloes of Automobile Wheels

STEEL instead of wood is now being used in a certain measure for the bands connecting the outer ends of the spokes of automobile wheels. This is due to the difficulty of obtaining properly seasoned hickory. The outer ends of the spokes are capped with steel ferrules to afford protection from water, the spokes being forced into the felloes under hydraulic pressure. Because of the large quantities in which the steel bands can be manufactured their use makes the cost of the wheels less than when wood is employed.



Using steel as a substitute for wood for the bands connecting outer ends of automobile wheel spokes

Washing Vegetables in Bunches for the Market

IT is perfectly natural that vegetables brought to market covered with dust or mud are not as salable as those presented to the purchaser in a clean and fresh condition. Many gardeners on a small scale lose a good part of their profit because they neglect to wash their vegetables before bringing them to market. Why? Because of the difficulty which the washing of bunched vegetables presents and the time it consumes.

A home device which overcomes this difficulty is shown in the accompanying illustration. Two half-inch pipes, each with one or more rows of small holes drilled into them on one side, are set parallel to each other in a two-armed reducing joint attached to a water-pipe. The two parallel pipes are closed at the free ends by caps. When the water is turned on it escapes through the holes in a number of fine but powerful streams which thoroughly clean the bunched vegetables.

A Windmill That Dodges a Kansas Cyclone

FUNNEL-SHAPED clouds chase one another about overhead, portending a heavy wind storm. Two men driving by a field in which is a pump operated by a windmill commented on the shortcomings of such apparatus.

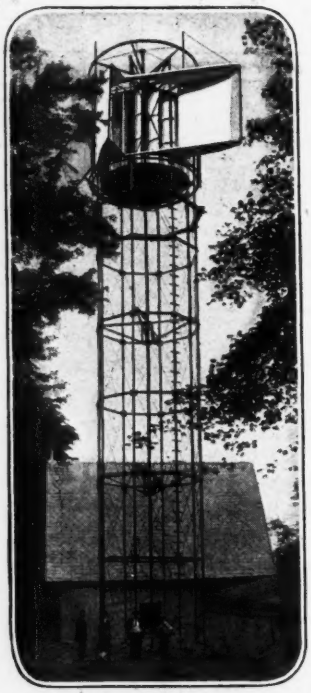
"The trouble with windmills," says one of the men, "is that you can't depend on their standing up under a gale. Now just watch."

But the expected did not happen. For when the storm broke, the wheel of the mill automatically slid to the base of the tower. Thus the witnesses to this operation learned of the invention of a windmill which could defy the destructive force of the power that operated it.

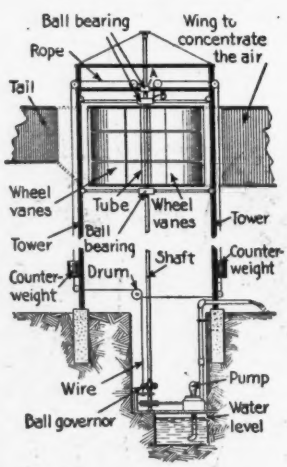
At the top of the tower was a cage which carried two vanes and a rudder. An inner cage, to which was attached a number of vanes, received the force of the wind directed against them by the outer cage, the vanes on the outer cage always turning the same faces to the wind.

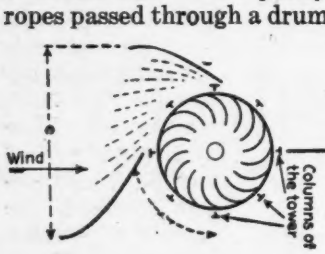
The wheel was attached to a tube suspended by ropes passing over pulleys at the top of the tower. The tube was made to slide along a shaft extending the length of the tower and operating the pump. A key attached to the shaft gripped it to the tube. The pulley ropes passed through a drum connected with a ball governor, the wheel in descent being kept in near equilibrium by weights attached to the ropes on each side of the tower.

When the force of the storm struck the vanes on the wheel and revolved the shaft at more than full speed, the ball governor released the brake on the drum, permitting the tube carrying the wheel to descend to the ground. The weights served to regulate the speed at which the wheel descended.



This windmill is more powerful than the ordinary windmill of the same diameter





Above, a cross section of the top and bottom parts of the windmill and to the left, a diagram of the wind wheel

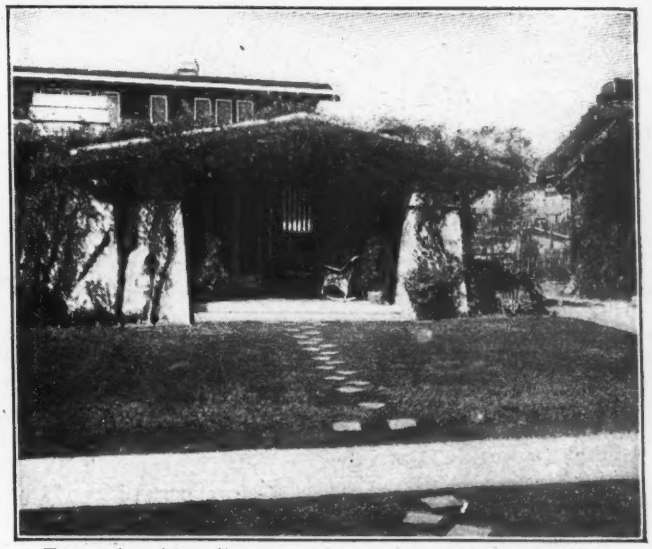
The Chance of Death in an Air Raid

WHEN an airplane flies over a city, dropping bombs indiscriminately, it is natural to consider a certain area within a definite radius of the bombs' explosive force as dangerous. A writer in a French periodical has recently given some figures that tend to show the comparative destruction of life wrought by these aerial missiles; and he comes to the conclusion that density of buildings and population increases the effectiveness of bombs dropped at random. Consequently, he asserts, the dangers are twice as great in Paris as in London. In open spaces, he figures from actual statistics, the chance of danger is one in 150,000, while in a well-built house it is but one in fifty millions. These figures are for London and based on the casualties in that city during recent air raids.

But, after all, figures won't remove the fear of death. There will, in all probability, always be some persons who regardless of assuring statistics, shall prefer to seek real or imaginary safety in cellars and dug-outs.

Millions of Horses and Mules in the War

MOTOR vehicles are used extensively for war purposes, but they have not entirely displaced horses. According to a statement by the British Premier Lloyd George, the British alone employ 2,000,000 horses in their armies. 5,000,000 horses and mules are in service on the West front. Many a ship-load of mules and horses has gone from this side across the "pond" to our allies in France and England.



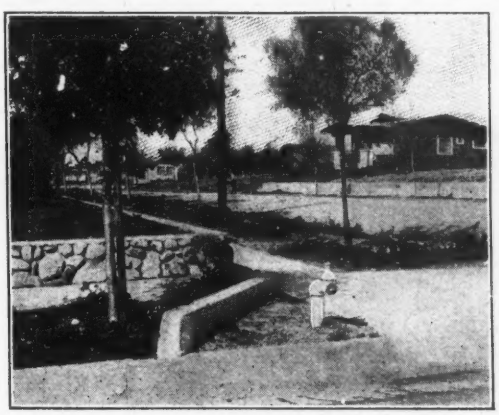
From the sidewalk you walk to the porch over square concrete slabs or stones "accidentally" dropped in place

A Curb That Protects Parkway Flowers

A CURB to protect the flowers and shrubbery growing in a parkway before a home from heavy rain torrents is shown in the accompanying photograph. The parkway is located on the side of a hill. Every rain-fall caused a flood of water to run over the street curb on to the parkway, sweeping away or inundating the growing things in its path. This having occurred several times the owner of the property decided on the extra curb as a means of prevention.

The curb is located at the upper end of the parkway, at an angle to the grade off the street, so that when the water rushes down the gutter and washes over the street edging it strikes the extra guard and is driven back. The curb is about nine feet in length, six inches in thickness, and from six to twelve inches in height. It is made of concrete with a smooth finish to match the sidewalk.

Since this extra curb was put in place the flowers have not suffered from rains.



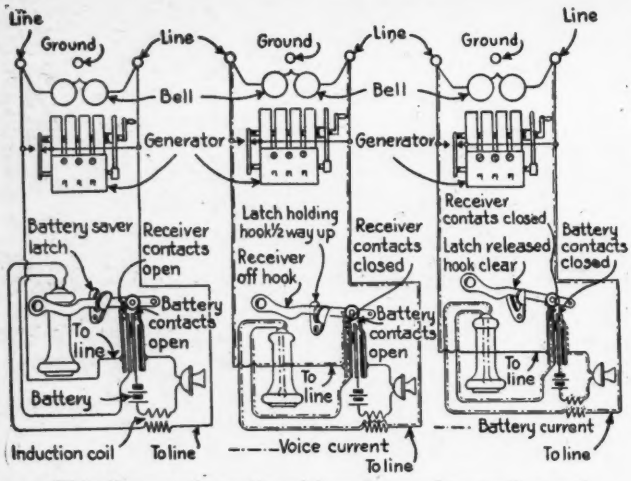
This extra curb of concrete was built to protect parkway flowers from inundations

Tiptoeing Your Way Across the Lawn on Stones

A NOVEL approach for the small home is made entirely of stepping stones—a pleasing contrast to the ordinary solid-concrete approach to a bungalow. This place is located in Pasadena, California, in a neighborhood enjoying a number of unusual features, among the most unique of which is this approach.

The concrete stepping stones or slabs used in this approach are 12 by 12 inches in size and are placed in an irregular manner from the sidewalk in front of the house to the front porch, giving them the appearance of having been "dropped" in place, rather than "laid" there. A few slabs have also been dropped between the sidewalk and the curb as the accompanying picture on top of the page shows. These slabs are four inches in thickness with a smooth finish on the upper side to match the sidewalk and the porch floor.

—ALBERT MARPLE.



This diagram shows the wiring of a rural party-line and the effects of the "battery-saver" when duly attached

Let Joy Be Unconfined! the Farmer's Wife Can Now "Listen In" All She Likes

"BR-R-R-ING! B-r-r-r-ing! B-r-r-r-r-r-r-ing!!"

"Oh my, that's Mrs. Simpson's call. I must hurry and listen in, and see what the news is up our way this morning."

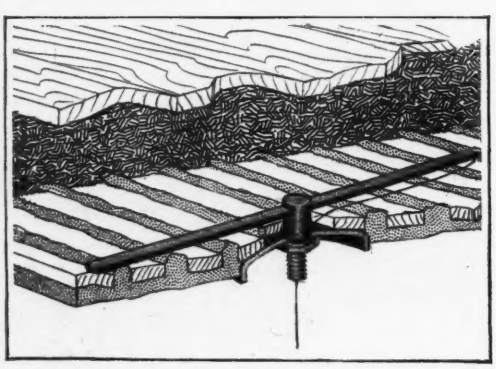
And the farmer's wife rushes to the telephone, and there hears all the news of the neighborhood. But all this is hard on the batteries. Every time any subscriber takes his receiver from the hook, he cuts in his local batteries, and they soon become exhausted.

An eastern telephone manufacturing company has devised an attachment which does away with battery wastage. It consists simply of a little latch, called a "battery saver." This is intended to be mounted on the outside of the telephone case in connection with the receiver hook. When this attachment is in use, taking the receiver from the hook to "listen in" simply cuts in the receiver alone. If one wants to break in on the conversation he pushes on the latch and thereupon the hook flies up another notch and the batteries and transmitters are cut in also, as well as the receiver. One can therefore both talk and hear, just as if the attachment were not present. But in the fact that it keeps batteries cut out except when wanted, the attachment renders an unusual service, and one likely to make it popular among party-line users. In fact it is the best aid to gossips we have seen in some time and imparts zest to rural life.

A Simple Economy Hanger for Wiring Old Buildings

THE wiring of old buildings, always a difficult and often an expensive matter, is made much easier and less expensive by a new work hanger recently invented and placed in the market. This device consists of a stud with a screw thread at the lower end and a square hole through its upper part. A bar fits into the hole.

To put the device in place, a hole is made in the plaster of the ceiling, large enough to admit the stud. The supporting bar is pushed into the square hole of the stud, so that the stud is near one of the ends of the bar. A wire leader is attached to the other end of the bar. The bar is pushed through the hole in the ceiling, at right angles to the direction of the laths. After the stud too has been pushed through the hole with its upper part, the wire leader is used to pull the supporting bar through the hole in the stud, so that the stud is in the middle of the bar. Then the outlet box is slipped over the threaded part of the stud and fastened securely by a lock-nut. This entirely obviates the necessity of having unsightly conduits on the ceiling and walls of the room.



A stud with a thread at its lower end and a bar in its upper part makes it easy to wire old buildings

FOR PRACTICAL WORKERS

Just a Piece of Sheet Iron and You Have a Camp Stove

HERE is a valuable stove idea for the camper, especially if he owns an automobile. Although it has been tried out and found satisfactory, its simplicity will cause its value to be questioned by many. It consists of a single piece of sheet iron 1/8 in. thick, 18 in. in width and 24 in. long. It can be purchased at any hardware store.

He dug a hole and laid a piece of sheet iron across it. The result was a camp stove

This piece of metal serves as the top of the stove only. When camp is to be made stones are gathered and arranged in two piles, these being placed at the desired height and the proper distance apart; then the iron top is placed on them and everything is ready for cooking. If no stones are at hand, which is seldom the case, a hole with sloping ends may be dug in the ground and the top of the stove placed over it

Two noteworthy features of this stove are the convenience of handling and lack of weight. It does not weigh more than 10 lbs. and, if carried in the machine, may be placed beneath the rug in the bottom of the car so as to be out of the way when not in use.

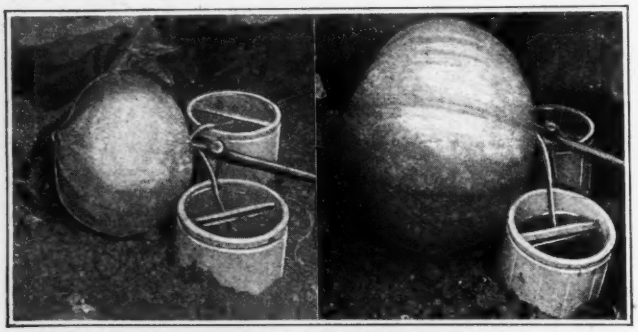
Starting Induction Motors When Coils Fail to Work

ALMOST all alternating current fans have starting coils that are automatically thrown out of circuit by a centrifugal device when the motor operates rapidly. Sometimes this device becomes deranged and does not break the connection, with the result that the fan fails to attain full speed and becomes overheated.

In a case of this kind where parts cannot be secured quickly to make the necessary repairs, the two ends of the starting coils may be connected to a piece of flexible cord and a push button connected to the other end to hang down within easy reach. To start the fan it is only necessary to turn on the current and hold the push-button down for a moment and the fan will immediately pick up speed, after which the button may be released. This kind of a repair may be made on any such motor where the starting coils are thrown out automatically when a certain speed is attained by thearmature. New parts should be procured as soon as possible to replace the makeshift starting circuits—JOHN D. ADAMS.

Injecting Water Into Vines to Make Pumpkins Grow Rapidly

PUMPKINS, vegetable marrows, etc., usually grow at a great rate; but their development may be hastened to an astonishing degree by feeding them through the stalk with plain water. Holes are made in the stems of the fruits and into these the ends of lamp wicks are pushed as shown in the photograph. The other ends of the wicks, which are preferably rounded, rest in jars of fresh water. The fruits seem to swell up as soon as they are connected with the water, and are ready for cutting in half the time. In this way individual plants can be made to bear much more heavily as the fruits tax the resources of their parent to only a small extent.—S. LEONARD.



Jars of water placed at the pumpkin stem for feeding it. The second picture was taken three days later

Drying Potatoes for Future Use Instead of Storing Them

IF the American housewife allows any waste or fails to put aside a generous supply of summer products for winter use it will not be because she has not been admonished and shown how by the Department of Agriculture. The latest exhortation is of special interest to those having too little storage space to accommodate the surplus potato crop.

Formerly the only thing to do with the white potato was to make a place for it in the cellar. But this year there will doubtless be double and triple the amount of potatoes for storing. This seems to be an argument in favor of the drying method.

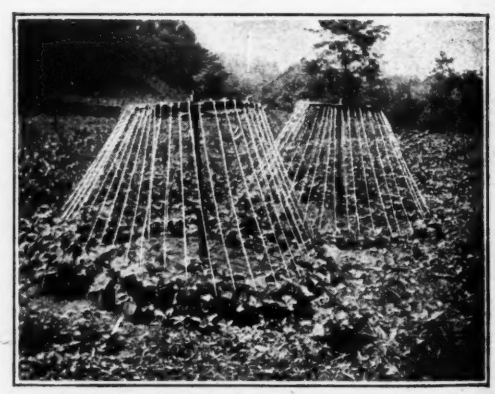
To be dried, potatoes must first be partially cooked. First peel them, cutting out all eyes and spots. Then cut into 3/16-in. slices and rinse in clear cold water. Arrange on wire trays in an ordinary home steamer, such as was described in the October issue of the POPULAR SCIENCE MONTHLY, and steam for fifteen minutes. The thicker the slices, the longer they must be steamed. When the potatoes are under-done the centers turn dark on drying and may mold quickly. New potatoes do not need to be steamed quite as long as old ones.

The steamed slices may now be placed on trays in front of an electric fan and the moisture driven off by a current of air of room temperature, or they may be placed in an oven heated to approximately 160°F. and dried until brittle. The former is the easier way if electric fans and current are available.

The dried potatoes should be stored in tight containers and kept in a dry place. Pasteboard boxes, paper sacks, or containers made of paraffin fiber, fastened to keep out bugs and other kinds of insects, are satisfactory and inexpensive.

Old Buggy Wheels Used for Training Growing Vines

A PERSON that took a great deal of pride in his small backyard garden used some old discarded buggy wheels for training his bean vines. Each wheel was supported by a substantial post with



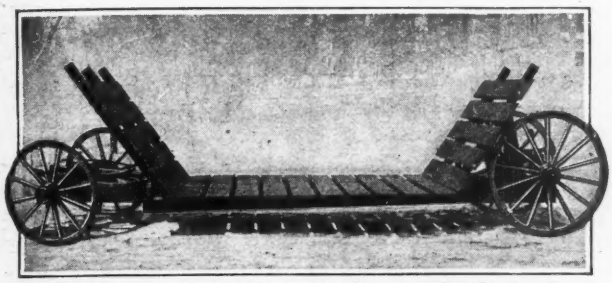
Buggy wheels mounted on posts with strings from the rims to make vine trellis

its upper end hewn down to fit in the hole in the hub. Stakes were driven in the ground in a circle of larger diameter than that of the wheel rim. Strings were then run from the stakes to the wheel rim and the beans planted near the stakes.

The vines climbing up the strings made a frustrum in appearance. At harvest time the beans are easily gathered from either side of the vines.

An Underslung Rack for Hauling Green Corn Fodder

BY those who are using the high flat rack for hauling the long, heavy bundles of green corn fodder to the silage cutter this underslung rack shown will be much appreciated. The expense of



The framework of this rack is hung under the level of the axles to make it handy for loading the fodder

building such a rack is not to be considered in measuring its convenience. If boards are lying around or taken from a building torn down there will be no cost other than the time for making the rack. To save time and avoid mistakes the rack is best made on a common wagon running gear of the regulation size.

The frame should be made of 4 by 6-in. material, 18 ft. long, bolted together in front and fastened to the underside of the front bolster with a long king bolt and nut. It is well to have an iron plate on the underside of the timbers for a bearing. The rear ends of the timbers are placed as far apart as possible and fastened to the underside of the rear axle with U-bolts. A 2 by 6-in. piece 7 ft. long is placed crosswise of the timbers just far enough back to allow the front wheels to turn easily and is bolted to the timbers.

The end guards need not be over 4 ft. high and braced as shown. Braces may be run from the 4 by 6-in. timbers up to the 2 by 4-in. pieces of the rear guard and the front guard may be braced by spiking the bottom of them to the timbers and allowing them to rest on the cross piece at the front.

Such a rack saves energy hitherto used in loading and is excellent for handling woven wire, green corn, fodder, posts and detached hog houses.—GUY S. ELLIS.

Removing Static Charges from a Moving Belt

TO remove the heavy static charges from a moving belt, the hangers, bearings, etc., are usually grounded. It will, however, be found advisable, in addition to such grounding, to install metal combs in the under side of the belt close to the point where it leaves the revolving pulleys, and also to treat the outside surface of the belt periodically with a mixture of equal parts of water and glycerin.

The generation of this static charge of electricity seems to be brought about by some internal movement of the particles or fibers of the belt structure, and the charge appears to be equally strong along the whole length of the belt. It is very little affected by increased tension, or slipping of the belt. Since the material of which the belt is made is usually a non-conductor of electricity, in order to dissipate the accumulated charge, it is necessary to render it conductive. This result is best accomplished by the use of metal combs and the application of water and glycerin as described.—PETER J. M. CLUTE.

Making Transparent Varnish of White Shellac

DISSOLVE one part of pearl ash in about eight parts of water; add one part of shellac and heat the entire mixture up to the boiling point. When the shellac has completely dissolved, cool the solution, and saturate it with chlorine until the shellac precipitates out entirely. When it is redissolved in alcohol, it makes a varnish which is as transparent as any copal varnish, and more satisfactory for a large number of purposes. This is a trade secret worth knowing.

Mounting Seaweeds on Cardboard for a Collection

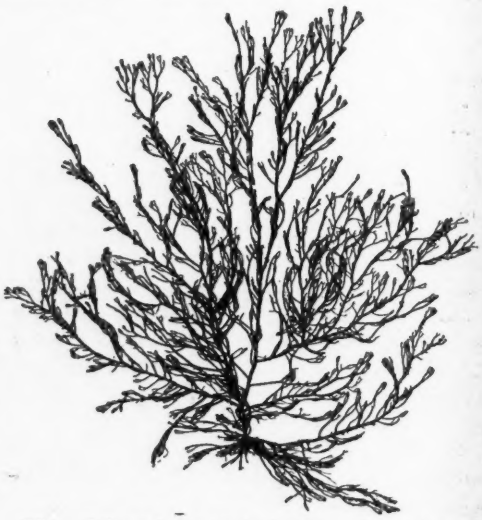
MAKING a collection of seaweed may be a difficult task for the average person as the regions where the different varieties may be found are limited. For this reason such a collection is valued and much sought after by the naturalist.

Three types of seaweeds. On the left, Dasya elegans (Jung); on the right, top, Plocamium coccineum; below, Grinnella Americana

Algae (the general name for seaweed) develop no roots with which to penetrate the sand and are therefore not adapted for sandy beaches or shallow places where small stones are continually being rolled about by the tides. The ideal place for them is where the shore suddenly slants to deeper water and where cliffs and crags are scattered over the white and sandy bottoms. Here the boulders will be covered with a thick, dense overgrowth. The time to gather the plants is after flood tide, when the waves have torn them from their moorings and washed them ashore.

If some of the plants should shrink while being carried from the beach to the home, they can be easily revived by being placed in a basin of water. Placing the plants in fresh water before preparing them for mounting also draws out the salt, which otherwise would crystallize after preparation. Usually plants which have been collected are cleaned of dirt on the spot by washing. After this they are placed in a shallow basin containing fresh water. A thick piece of paper or cardboard is placed in the dish, while the plant to be prepared is placed on top of it so that it just floats above the paper. One must be careful not to use the same water for all algae or to leave the specimens too long in the bath, for some red varieties lose their brilliant color in fresh water. The delicately red-tinged kinds should be prepared on the cardboard under salt water. To prepare seaweed for mounting the plant is placed in a shallow dish containing water, a piece of cardboard is slipped beneath it and the whole plant is then carefully spread out either with a long pin or thin pincers so that it shall assume a natural appearance. To spread the thin threadlike forms a delicate touch is essential. When the plants have been spread, the cardboard is cautiously withdrawn from the water with the algae clinging to it, care being taken not to disarrange it. As a rule some parts of the plant must be rearranged after it has been withdrawn from the water. In this case, that part which is to be retouched is first wet with a brush and then placed in the desired position with the pin.

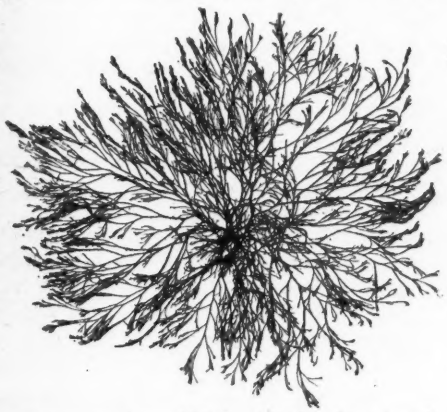
Only the thicker and tougher plants may be pressed with impunity. Place a number of layers of newspaper over them. The first pressing should be moderate and



This delicately branched alga, Ceramium rubrum, with rich, red tints is very ornate

only for a short time, then the paper should be taken off and fresh layers used.

If they are pressed for long periods at a time they will stick to the paper covering, but if the pressing is gradual with



Evermore beautiful is this deeply colored seaweed, Polysiphonia variegata, with its numerous branches and delicate leaves

frequent changes of the newspapers, the algae will stick to the cardboard. Those which do not stick to the cardboard may be glued to it with the white of an egg.

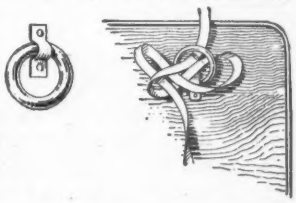
That Old Clothes Brush—Use It for a Door Check

A CERTAIN door in our house would not stay where it was set, and as it was a nuisance to prop it all the time, and not wanting to purchase a door stop, one was devised as shown in the illustration. A clothes brush that was somewhat worn was placed under the edge of the door, and when the door was moved the brush would slide along on the floor and hold it there in the desired position. There is just enough spring to the remaining stubs of the brush to hold it in position, yet not enough pressure is exerted to keep the brush from sliding on the floor. Usually every household can draft such a brush to do this duty.—KARL CHASE.

Old brush under door edge

A Dash Fastener for the Driving Reins

AN iron harness ring about 2 in. in diameter is sewed, riveted or nailed inside the dashboard of a buggy or wagon for a rein-holder. This will be found a convenient and safe way to fasten the reins with a simple hitch which can be quickly freed by one jerk. It is not unsightly or in the way when not in use.—A. S. THOMAS.



A ring attached to dash to hold reins

Pointers on the Care of Tools to Prevent Rust

ALL experimenters should know how to take care of tools for laying away in the tool chest to prevent rust. A tool may appear to be in first class condition but a little carelessness will reduce its lasting qualities and prevent it giving good service. Caoutchouc oil has proven itself invaluable in preventing rust. It is spread on the tool with a piece of woolen cloth in a very thin layer and allowed to dry. This coating will give protection from the weather and will not show any cracks even after standing a year. If it is desired to remove the coat just treat it again with the caoutchouc oil and after a day rub it off.

The wood parts of tools, such as stocks of planes and handles of chisels, etc., can be French polished, which gives them a fine appearance, but polishing does not make them retain their durability. It is best to soak them in linseed oil for a week and then rub them thoroughly with a cloth each day for two or more weeks. This produces a beautiful surface and at the same time acts as a preservative.

Articles of steel can be preserved from rust by placing a lump of freshly burnt lime in the box where they are kept. If this treatment is given to tools that are used quite frequently place the lime in a muslin bag. The lime will last well if the place is quite free from damp. Tools that are used almost constantly can be

kept from rust by placing them in a box over night that is filled with pulverized slaked lime. Before using a tool rub it well with a woolen cloth.

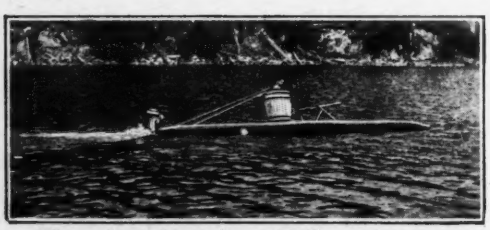
Rust may be removed as follows: Cover the metal with sweet oil and rub it well. Then let it stand for forty-eight hours. Smear the tool with oil, applying it freely with a piece of cotton wool or a feather. Rub well with unslaked lime, which has been reduced to a fine powder, and then immerse it in a strong solution of potassium cyanide with proportions of ½ oz. to a wine glass of water, allowing it to remain until the rust loosens and comes off. Remove the tool and clean it with a tooth brush, using a paste composed of potassium cyanide, castile soap, whiting and water, mixed into a paste of about the consistency of thick cream. Potassium cyanide is extremely poisonous and should be handled with great care so as not to allow any of it to enter a cut in the flesh.—E. STANDIFORD.

Applying a Coat to Ivory to Make It Look Like Silver

IMMERSE the ivory in a dilute solution of silver nitrate after having thoroughly cleaned it. Then put it into a solution of common salt until it assumes a deep yellow color. Dip it in water, and expose it to the sun's rays until it becomes black. On rubbing, the black surface will soon change to a brilliant silver.

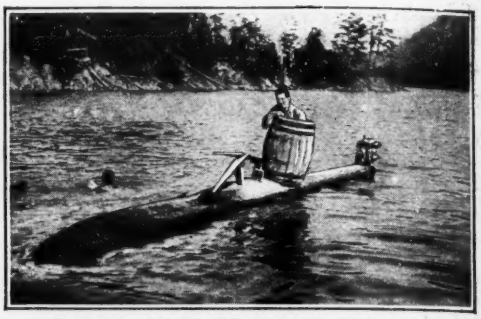
Making a Submarine Decoy of an Old Cedar Log

THE "submarine" here illustrated was made of a flat cedar log about 25 ft. long by 3 ft. wide. One end was cut off



The submarine going at full speed across the bay in a drive at an imaginary enemy

square and a piece of 12-in. plank nailed upright to it and to this plank was attached a rowboat motor. Steering was accomplished by running two ropes from the engine to the "conning tower." The "U-23," as she was dubbed, made the

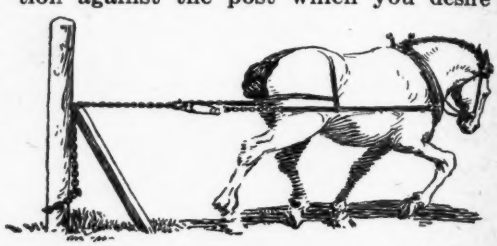


A small detachable motor drives the submarine. A gun is mounted in front of a barrel serving as a conning tower

rather surprising speed of four miles per hour, and caused quite a sensation as she sailed along the bay.—R. T. PENDRAN.

Let Old Dobbin Pull Up the Old Fence Posts

THIS is a very simple post puller. It consists of a 2 x 6-in. timber about 3 ft. long, placed in a slanting position against the post which you desire



With a piece of plank, a chain and a horse, fence posts are easily pulled out

to pull out of the ground. Fasten the chain around the post just above the ground and run it over the plank. The next step is to hitch a singletree to the end of the chain and one horse easily pulls out any ordinary fence post. This device will be found very handy by farmers repairing their fences or tearing out old ones to replace them by the modern steel or concrete fence posts which have won such great favor among farmers generally. The chain may be quickly attached to any post and the prop put in place. The parts are easily carried to the next post to be drawn.

A Handy Substitute for a Paint Striping Brush

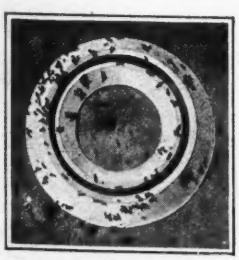
THE amateur will usually find that striping his remodeled speedster is a difficult job, especially with such brushes as he happens to have on hand. An excellent method of producing neat stripes is to use the striping paint in a draftsman's ruling-pen, using a yard-stick to steady the hand or guide the pen.

Catching Ants in Pie Tins—How It's Done

IN the western states there is a large red ant whose bite is very painful and lasting in its effect. When a nest of these ants becomes established it can only be eradicated by persistent and continued application of a strong poison in the form of powder sprinkled around the hole. No amount of water will drown them out. As the poison method is slow and somewhat dangerous, the writer devised a trap which is very effective, and if kept in place long enough will eliminate the whole tribe.

Cross section of pie tins over the ant holes to trap ants

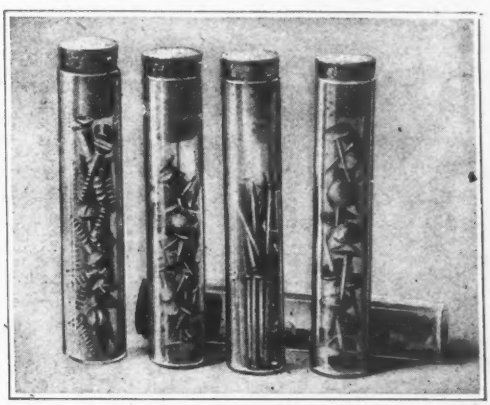
The base consists of an annular disk of tin about 8 or 9 in. in diameter. On this are mounted two rings made by cutting out the bottoms of two pie plates, one large and one small. When the three parts are assembled the result is a circular track with two sloping walls, separated by a space $\frac{3}{8}$ in. wide at top. The outer walls should be coated with paint so that the ants can easily run up. The trap is then placed over the nest with the hole in the center. Now, ants are always either coming or going, so that in the course of a few minutes almost every ant must run either up the outer or inner wall. This they do with great speed, as the entire nest becomes excited. The result is that they tumble in by the hundreds, and are unable to escape, as they cannot climb up the shiny interior surface when they are upside down. In the hot sun the inside of the trap becomes very warm. The heat soon kills the ants.—JOHN D. ADAMS.



Top view showing ants being trapped

Convenient Method of Keeping Brads and Screws

HOW do you assort and preserve all the various kinds of brads, screws, tacks and rivets required in a well-ordered household? See if this method doesn't appeal to you. Procure a number of wide-mouthed "homeopathy" vials, with corks, and keep them filled with these little articles. They require no labels since the contents are always visible and they are protected from dust and rust. The little bottles containing photographic developer can be had from any amateur photographer and are just the thing after the wrappers are removed with warm water.—W. H. SARGENT.



Small vials inclosing screws, tacks, nails and the like, in which they may be easily seen

Saving Undersize Bushings and Liners by Plating

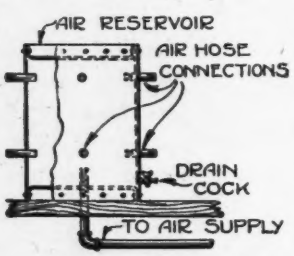
EXPENSIVE brass and bronze bushings are often thrown out of production and consigned to the scrap pile at inspection benches on account of being turned undersize. These may be saved by building up the diameter with copper plating, the expense of so doing usually being slight in comparison with the value of the article.

Silver Plating That Will Not Scale When Burnished

WHEN silver-plating steel or brass articles, much annoyance is caused by the scaling off of the silver during the burnishing process. This may be very easily avoided by immersing the article for a few minutes in a hot solution of potash or soda, and rinsing it without handling in water. It should then be dipped in dilute nitric acid, removed and scoured with a stiff brush or fine sand if necessary. Attach the wire, dip it again momentarily in the acid, pass it rapidly through clean water and immediately place it in the circuit in the bath.

Compressed Air Manifold for Boiler Shops

IN boiler shops where a large number of pneumatic tools are constantly in service it is quite impossible at times to make a connection with the air main without using several lengths of hose. Again, where there are several leads or connections branching from a drop line, part of the efficiency of the tool is lost due to the pipe not being able to supply air at the proper working pressure fast enough.

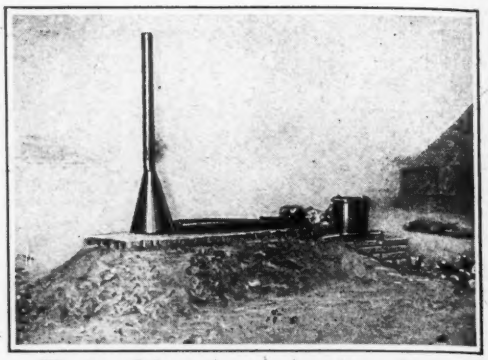


One of the storage air drums for shop use

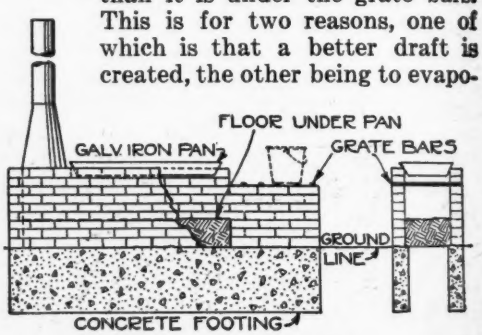
In order to eliminate trouble several compressed air drums about 14 in. in diameter and 20 in. long were placed in various parts of one shop, fitted up as shown. Several pipe nipples are placed in the drum. Stop cocks were placed on the nipples, into which another nipple is screwed and a hose connection placed thereon. A drain cock is placed at the bottom of each drum to drain off any water which may accumulate. Several lines can be attached to the drum without loss of efficiency as the capacity is large enough to maintain an equal pressure. This arrangement also effects a saving in pipe lines and maintenance as well as the volume of compressed air necessary to fill the pipe lines.—J. R. MINTER.

Burning the Camp Garbage—How the Army Does It

AS a part of the sanitary system adopted by the Government for the guardsmen on the Mexican border last season, a garbage incinerator was devised which has proved quite efficient. The details are fully given in the illustrations. The wood fire is built in the opening under the pan, and into the latter all liquids are thrown and boiled down, the resulting residue being raked out and thrown into the fire. All solid matter, such as parings, etc., are thrown directly into the fire and burned. The grate bars over the open end of the incinerator are used to hold pails of water which are heated to wash the guardsmen's mess kits. It will be seen in the illustration that the bottom of the fire-box is about 1 ft. higher under the pan than it is under the grate bars. This is for two reasons, one of which is that a better draft is created, the other being to evaporate the liquid remaining in the garbage more quickly. This incinerator may be built with a brick chimney instead of the sheet-iron pipe.—GEORGE M. PETERSEN.



The top of the garbage incinerator as it was built for camp use by the American soldiers



Plan of the incinerator showing method of construction with concrete base

Simple Designs for Sheet Metal Working

XV.—Development of patterns for sheet metal work by triangulation

By Arthur F. Payne

Director of Vocational Education, Johnstown, Pa.

THE development of patterns by triangulation is a subject of great interest to sheet metal workers. Many arguments and discussions have been held concerning the manner of developing patterns for certain pieces. Many workers claim to possess the "secret" of triangulation, and decline to divulge it. Others have the ability to develop certain patterns but not others. All of this misunderstanding and acrimonious debate will be cleared away if we get an understanding of the following three points: First, most of the difficulty in learning triangulation is caused by the fact that most of the workers want to start right in on triangulation before they have mastered the preliminary work leading up to it; therefore, all new readers are advised to work out all the problems in the previous issues. Second, there are three different ways of developing any pattern by triangulation, and securing the "true lengths" and all three of these ways are right. Some workers use one way and some another, but all three are based upon the same principle. Third, many students of triangulation fail to get a thorough understanding of the fundamental principle upon which triangulation is based. Like many other essentials, this principle is difficult to explain and somewhat difficult to grasp, but very simple and enlightening when mastered.

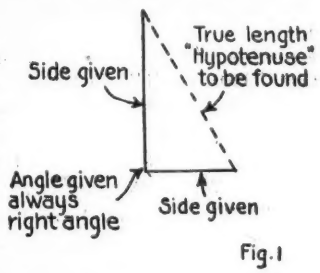


Fig. 1

The problem of finding the hypotenuse with two sides given

The illustrations (Figs. 1 and 2) show this principle which is merely one of the simplest problems of plane geometry and is stated thus: "Given two sides of a triangle and an angle, construct the triangle." In our case this problem is very much simplified by the fact that the angle given is always a right angle and the side we have to find is always the long side of the triangle called the "hypotenuse." This is illustrated in Fig. 1. In every pattern developed by triangulation we are always trying to find the "true length," which is always the "hypotenuse" of the triangle. We will obtain from the front and top view the two "given sides." The angle is always a "right angle" which is an angle of ninety degrees, commonly called a square corner, and the hypotenuse is the "true length," we have to find.

The problem of finding "true lengths" is shown in Fig. 2. The front view (1) is a drawing of an ordinary 30-60 draftsman's triangle and (1) top view is the top view of the same triangle. Now it is very easy to see that we already have the three sides of this triangle; therefore, no problem is presented. However, if we swing the triangle around until its edge is facing us, as in 2, we have a problem in triangulation. We are given one side in the front view which we will draw as A-B of 2 of the "true lengths." Another side is given to us in the top view. This

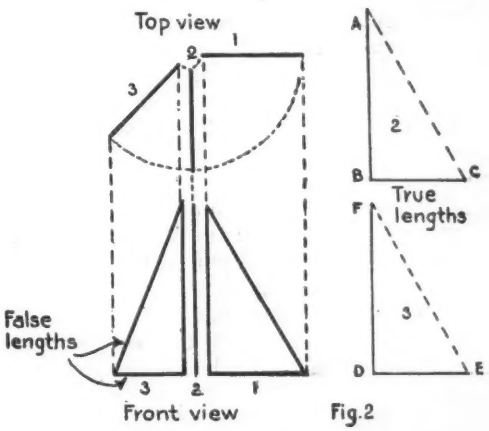
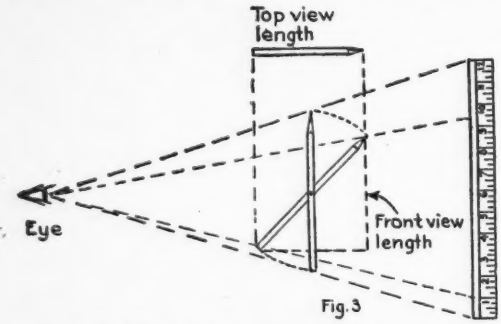


Fig. 2

Finding the true length of the hypotenuse when lengths of the other two sides are known

we will draw as B-C and the line we wish to obtain is readily drawn as the dotted line A-C. Now look at front view (3). Two lines are false lengths because they are "foreshortened" or pointing towards us, as shown by the top view. The top view line is a "true length" line drawn as



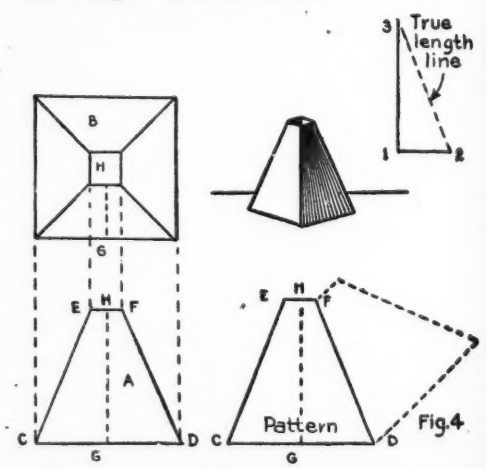
Illustrating the method of foreshortening with pencil and a one foot rule set upright

D-E of the "true lengths;" draw the front view "true length" line as D-F then draw the dotted "true length" line F-E.

The illustration (Fig. 3) is another interesting method of demonstrating the same principle. Place a 1-ft. rule upright on a table, hold your pencil at arm's length, move away from or towards the rule until the ends of the pencil and the rule coincide as shown; then, holding the pencil in the middle, turn the point towards the rule. Measured by the rule it will become apparently shorter. This is what we call "foreshortening." At an angle of forty-five degrees it will measure only 8½ in. The top view length is false because the butt is receding from us; the front view length is false because the point is receding from us; but if we arrange the top and front view lengths to form a right angle, as shown by the dotted lines, the pencil will be the "hypotenuse" or "true length" of the pencil which is what we are after.

The illustration (Fig. 4) is a very simple practical problem that illustrates the practical use of the theories advanced. The piece illustrated could be used for a square pipe reducer; upside down it could be a hopper. Its geometrical name is "truncated pyramid." The steps taken to develop the pattern by triangulation are: First, draw the front view, *A*, and top view, *B*. As the four sides are exactly alike it will only be necessary to develop one side, that shown in the front view, *A*. Notice that the lines, *C-D* and *E-F*, are shown in their "true length," but that the lines, *C-E* and *D-F*, are "foreshortened"; the top is leaning away from us. If we can get the "true length" of the dotted line, *G-H*, that will give us the height of the center of the pattern, and as we already have the "true length" of the top and bottom, we will only need to connect the top and bottom with the slanting side lines to complete the pattern.

To get the "true length" of center line, *G-H*, set the length, *G-H*, of the top view off as 1-2 of the "true length" triangle. Then set the length, *G-H*, of the front view off as 1-3 of the "true length" triangle. The dotted line, 2-3, will be the "true length" of the center line, *G-H*. Right here you have an excellent opportunity to grasp the fundamental principle of triangulation. Notice that we are treating the lines, *G-H*, of the front and top views the same as we did in 2 of Fig. 2, that is, as the top and edge view of a triangle; and having two sides of a triangle and the right angle it is very easy to draw the third side which is the "true length" line we want.



Developing a pattern for a truncated pyramid using the triangulation method given

Now set off the line, 3-2, as *G-H*, of the pattern, draw the top line, *E-F*, and the bottom line, *C-D*. Connect with the slanting lines, *C-E*, and *D-F*, and the pattern for one side, is complete. It is only necessary to complete the pattern four times as shown by the dotted pat-

tern and the pattern for the "truncated pyramid" will be complete.

The illustration (Fig. 5) shows the method of developing the pattern for a "compound offset." This is used in furnace piping that runs up inside the partition of a room. If the partition of the second floor runs at right angles to the partition on the first floor the rectangular furnace pipe must be changed so that it will fit into the partition. This compound offset is placed between the floors, over the first floor partition and under the second floor partition.

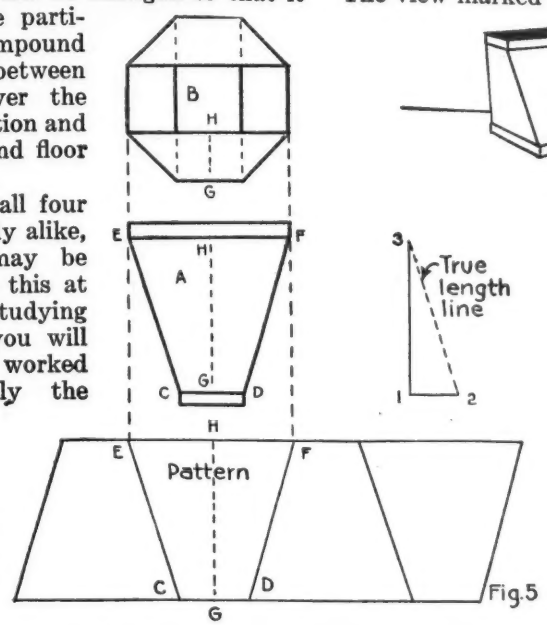


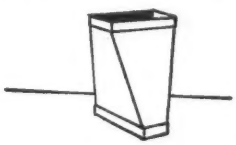
Fig. 5

Using the triangulation method for developing a pattern for a compound offset in furnace pipes

Notice that all four sides are exactly alike, although it may be difficult to see this at first. After studying this problem you will find that it is worked out in exactly the same way as problem Fig. 4. First, draw the front view, *A*, and the top view, *B*. Notice that the lines, *E-F* and *C-D*, are, "true length" lines. If we can get the "true length" of the dotted lines, *G-H*, we can easily lay out the entire pattern. Set off the length, *G-H*, of the top view as line 1-2 on the "true length" triangle. Set off length *G-H* of the front view as line 1-3 of the triangle. Draw the dotted line, 3-2, which is the "true length" of line *G-H*. Set this line off as *G-H* of the pattern. Draw lines *E-F* and *C-D*. Draw the slanting side lines, and the pattern for one side is complete. Reverse the pattern for the other three sides and the pattern for the compound offset for furnace pipe is complete. Allowance must of course be made for the flange at the top and bottom and for the seams.

The illustration (Fig. 6) shows a real problem in triangulation. The problem chosen is a rectangular register box with a round inlet but the method used to develop the pattern would do equally well for a square to round, or rectangular to round, pipe fitting, or it would do equally well for a hopper leading into a round pipe.

The small sketches on the left show other forms of register boxes. The one on the right is a sketch of the register box we are to develop the pattern for. The view marked *A* is the front view, the one marked *B* is the top view; these must be drawn first. If we study these two views we will see that the pattern cannot be developed by the "parallel line" method or the "radial line" method, so we shall use the "triangulation" method. But the reader may ask "How do we know that the pattern can be developed by the triangulation method, or even developed at all?" The author of this series has had many interesting discussions with the sheet metal pattern drafters and has had submitted to him many problems said to be impossible of development. To settle this point let us remember that if the subject is straight in one direction on its entire surface, it can be developed. By this I mean that if we place the edge of a rule on the problem and it touches along the entire edge and we can cover the entire surface by moving the rule, we can develop the pattern. If we should place a short rule vertically on this register box and move it around, we could cover the entire surface. We should also find that on the four sides there would be large triangles that would be flat. The triangles have been outlined in pencil because they are an important part of the development. They are marked *C-D-E-F* on the top view and on the pattern. On these triangles the rule would lie flat in any direction. In the corners we should find



a place that is straight one way and curved another. To develop this surface we break it up into a number of small triangles.

After we have drawn the front view, *A*, and the top view, *B*, we next lay out the large triangles, *C-D-E-F*. The next step is to get the pattern of the large triangle, *C*. Notice that the side, *G-H*, is in its true length so we can project that down and start our pattern with that line. Now we have to get the length of the sides of the triangle, *C*. This is done by triangulation in the following manner: We must consider that the line, 5-*H*, in the top view is the top view of the triangle, 5-*H*-*K*, in the front view. The line, *H*-*K*, is a "true length" so we project that over to the right. Then we take the distance, 5-*H*, from the top view and set it off as *K*-5 on the "true length" triangle, and the dotted line, 5-*H*, will give us the "true length" of the side of the triangle, *C*. Set off this line on the pattern, both sides of this triangle are alike, so make the side, 5-*G*, the same as 5-*H*.

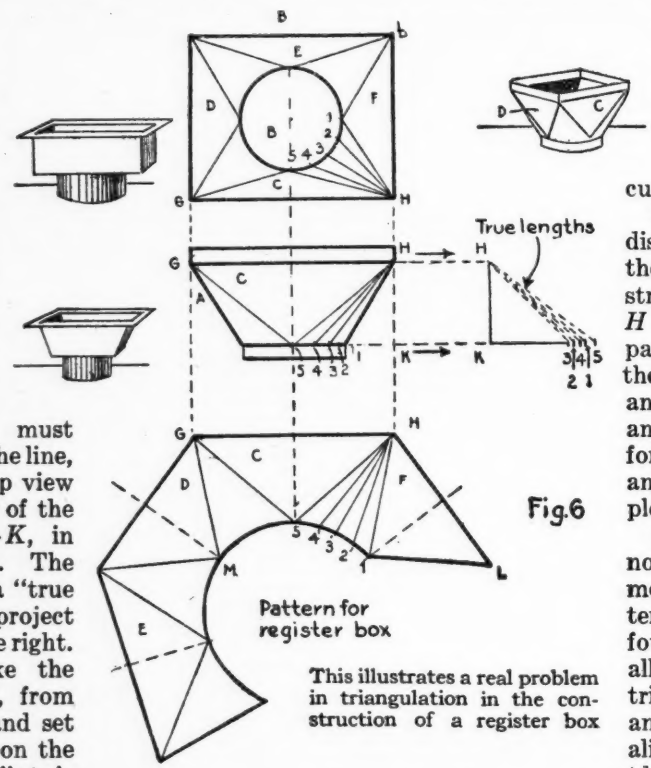


Fig. 6

This illustrates a real problem in triangulation in the construction of a register box

Now divide the one quarter of the circle on the top view into four equal parts. Number them as indicated and draw lines from these numbered points to the corner, *H*. If we can now get the "true lengths" of these lines we can lay out our pattern, because we know the correct distance between them is shown by the numbered points on the quarter circle.

So we have to get the "true length" of the line, 4-*H*. Think of 4-*H* on the top view as the top view of the triangle, 4-*H*-*K*; the line *H*-*K* is a "true length." Project it over to the right. Set off 4-*H* of the top view as *K*-4 on the "true length" triangle and the dotted line, 4-*H*, will be the "true length" of 4-*H*. Now take the distance, 5-4, of the top circle and set it off as 5-4 on the pattern circle by striking a short arc. Then take the "true length" line, 4-*H*, and set it off as 4-*H* on the pattern. Repeat exactly the same process for lines 3-*H*, 2-*H*, 1-*H* and connect the points with a free hand curve.

Then take the distance, *H*-*L*, of the top view and strike an arc from *H* to *L* on the pattern. Take the distance, 1-*H*, and set off as 1-*L* and the pattern for the end triangle, *F*, is complete.

Now we need not develop any more of the pattern, because the four corners are all alike and the triangles, *C*, *E*, and *D*, *F*, are alike. So lay out the triangle, 5-*G*-*M*, the same as 5-*H*-1. This gives us one-half of the pattern. Then slip the pattern along to the left until the line, 1-*L*, matches the line, *M*-*G*, and the whole pattern is complete.

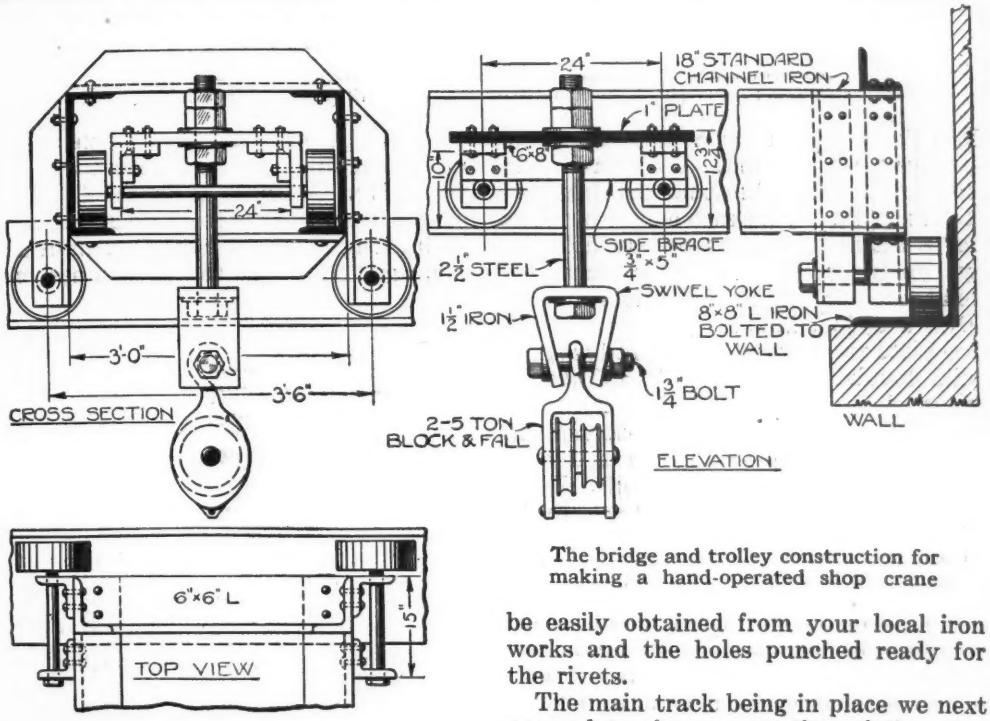
The students of this series are cautioned not to expect to grasp these problems without studying them carefully, and working out every one conscientiously. If any difficulty is experienced with this register box pattern, read the entire article over again. It is very important to grasp the principle of triangulation thoroughly at this time because the successful solution of the problems planned for the future will depend upon a thorough grasp of this underlying principle.

(To be continued)

How to Make a Hand-Operated Crane for the Shop

THE crane shown in the illustration is easily and cheaply constructed in your own shop and is suitable for wood as well as brick structures. The idea is to provide a means of transporting, lifting or carrying any heavy casting, piece of machinery, automobile motors, transmissions, axles, boxes and heavy parts to be shipped, to remove a heavy forging from the lathe to the planer or drill press and numerous other lifting jobs. Use standard 18-in. channel iron for the cross bridge and extra heavy 8-in. by 8-in. angle iron for the side wall or main track. The angle irons run the longitudinal length of the building while the channel iron runs the cross length and are cut to fit in between the angle irons, allowing sufficient clearance so that the rollers will not jam against the sides.

The angle irons should be drilled and countersunk every 24 in. with a ⅞-in. drill. They are bolted to the wall as shown. If the wall is brick set a pilaster of brick 12 in. square under the angle iron to hold it up. Make the pilaster of good brick and best cement mortar with a 12-in. footing below the floor line. If it is a frame structure use a 10-in. I-beam with its base set in a concrete footing made up as follows: 1 part cement, 2 parts sand and 4 parts coarse gravel, all to be well mixed and the columns set in at once and braced up straight. These are allowed to stand until the concrete has completely hardened before the other work is continued. Connect the columns to the angle iron track with ½-in. corner plates 6 in. by 6 in. and riveted with 8 ¾-in. rivets in each one. The iron may

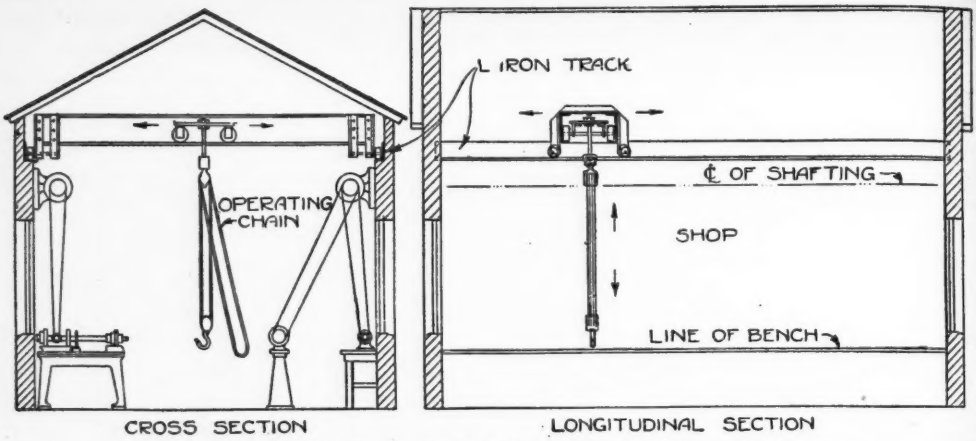


The bridge and trolley construction for making a hand-operated shop crane

be easily obtained from your local iron works and the holes punched ready for the rivets.

The main track being in place we next proceed to the construction of the cross movable bridge and the traveling block carrier. The bridge is made from two lengths of 16 or 18-in. channel iron, bolted or riveted together by heavy 6 in. by 6 in. angle irons at each end, top and bottom. On both sides at each end are two pieces of 5 in. by 5 in. angle irons riveted in place and a hole drilled through both pieces for a 1½-in. bolt, which is used for an axle.

Build the carriage frame as shown, 24 in. square with a top plate 24 by 30 in., to which are riveted four 6 in. by 8 in. angles, and two cross braces ¾ by 5 in. Drill holes on the lower ends of the bottom



Cross and longitudinal sections of a building showing how the tracks are placed to carry the bridge and trolley runway when placed in the shop

legs for a 1½-in. axle and use 10-in. pulleys for the wheels. A 3 or 4-in. face to the pulleys will be about the right size. Drill a ¼-in. hole in each end of the shaft for a cotter or a small bolt to hold the wheels in place. A washer is placed behind each wheel to make it run free. Drill a 2½-in. hole in the center of the top plate and fasten a 2½-in. rod securely with double lock nuts. Make a U-shaped piece of band iron and drill a 2½-in. hole in the center and two 1¾-in. holes in the legs, through which run a 1¾-in. bolt for hanging the pulley block. Use a good standard steel block and chain with safety stop and large hook of forged steel at the bottom.

The universal action of this homemade crane makes it an almost indispensable accessory in all mills, repair shops and garages, and especially machine shops, as it can cover every part of its area of travel. It will carry several thousand pounds easily and can be pushed from place to place by one man.—P. P. AVERY.

Stanchion for Holding a Hog Fast While Ringing His Nose

THE hog holder illustrated may be made of 1¼-in. oak or pine. The frame is made first from two pieces *A* 3 ft. long, two pieces *B* 38 in. long and two pieces *C* 31 in. long. A hole is bored in one end of the pieces *B*, which are then securely fastened together. Cut a piece *D* 45 in. long and bore a hole in each end and bolt it to the cross piece *C*. Cut a piece *E* 3 ft. long and bore a hole in the lower end and one 10 in. from the top where it is bolted to the piece *C*. This makes it ready for the lever F, which is 30 in. long. Bore a hole 9 in. from the top, one 10 in. from the bottom and one

Details of a stanchion which is placed in front of a hog house door for catching and holding a hog while ringing his nose

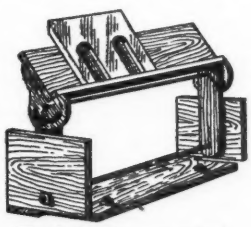
in the bottom of the lever and bolt it to the end of *B* as shown, then make a piece *G* 30 in. long and 2½ in. wide and bore a hole in each end and bolt it to the top of the pieces *D* and *F*.

Make a connecting piece 20 in. long and 2½ in. wide; then bore a hole in each end and bolt it to the pieces *E* and *F*. Cut six notches in the piece *B* 1 in. deep

and let the right side slant towards the lever. Make the piece *I* 10 in. long and 1 in. square, bore a hole in the end of it and bolt it to the lever as shown. Fasten the hog-holder in the hog-house door when you are ready to ring his nose and the work can be done easily by one person.—H. V. STANLEY.

An Ingenious Grinding Rig for Steel Knives

A GRINDING rig as shown in the illustration will be found a welcome addition to any woodworking establishment or wherever a large number of knives need to be ground.



Knife holder to grind edge at proper angle

It is especially quick and handy for thin steel knives, for, no matter how short they are, it is difficult to hold them by hand to a uniform level. It is instantly adjustable to any level, or width of knife, using a small or large grinding wheel. With it knives can be ground perfectly straight without any trouble or loss of time.—J. C. GRINDELL.

A Coating for Drawings to Preserve the Lines

WASH the drawing well with a solution of isinglass. Prepare another solution by dissolving 1 oz. of Canada balsam in 2 oz. of best oil of turpentine. Coat the drawing with this, using a camel's hair brush to obtain an even surface.

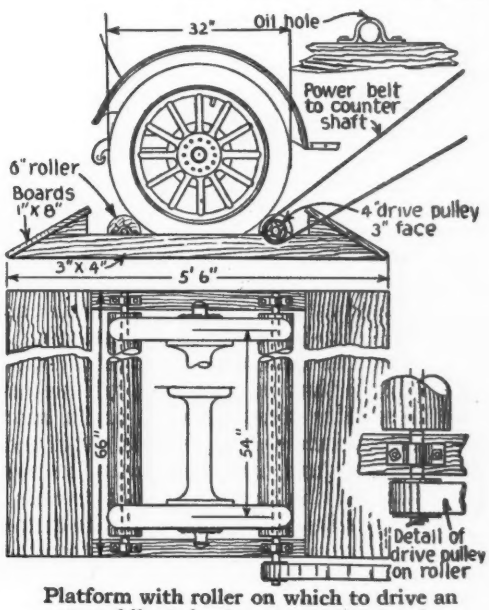
Photographic Plates Used for Mounting Pictures

FOR mounting post-card photos an excellent and unique mount, I have found, can be made easily and conveniently by taking an old post-card plate and removing the emulsion by pouring hot water on it and scraping off with a sharp knife. The plate is then dried, placed over the face of the post-card photo, and both are bound together along the edges with lantern-slide binder or adhesive tape.—H. K. CAPPS.

An Automobile Engine Used for Driving Stationary Machinery

THE automobile appears to be the first power-propelled piece of machinery a farmer will purchase and its power plant is useless when not employed for its intended purpose. Many devices are manufactured for utilizing the engine power for driving stationary farm machinery, but the handy man in his leisure hours can construct such a device that will answer the purpose just as well. The illustration shows one of these devices.

Make a frame of 3 by 4-in. hemlock timber with crosspieces of 2 by 4-in. pine. Procure two rollers 6 in. in diameter and as the tread of the automobile. These may be turned up at a local wood or metal working shop and the ends of the shaft fitted in bearings nailed or bolted to the timbers. Attach a pulley on the end of one of the shafts. The ends of the timbers are sloped and boards are nailed on them so that the automobile can be run up and on the rollers, as shown. Block the front wheels in front and behind, then with the gears thrown in high, a most efficient power plant is obtained. This device does not cost much to make and it will do the work in

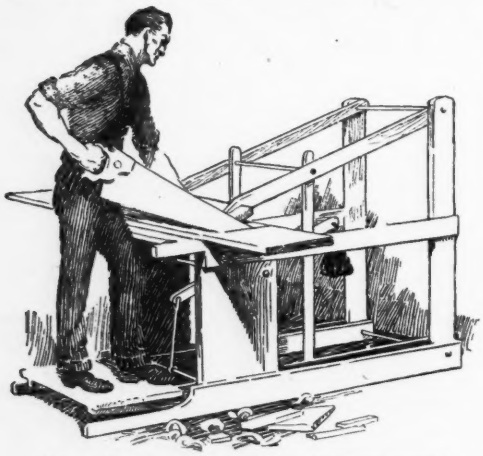


Platform with roller on which to drive an automobile for using it as a power plant

place of a small stationary engine or electric motor.—P. P. AVERY.

A New Type of Carpenter's Saw-Horse

WHILE this saw-horse may appear to be cumbersome in use the operator will find it a great convenience. The upper swinging arm or jaw is operated through connecting arms by the foot treadle. A



An elaborate saw-horse for holding boards of various widths and different thicknesses

counterbalance weight is attached to open the jaw when placing a board in or taking it out. The operator stands on the treadle which clamps the boards on edge for sawing.—A. S. THOMAS.

Kinds of Hand-Saws to Use on Hard and Soft Wood

WOOD-WORKERS, generally, in choosing a saw for a given job, will estimate the efficiency of the saw by the appearance of the work after the cut is made. This can be the cause of very serious errors in fine work, such as cabinets, ship-joinery, etc., particularly where several men are employed. It is well known that no two men will use a tool in exactly the same way, and a saw that will produce a clean, smooth cut in the hands of one man may make a cut far less true when in the hands of another man.

Setting aside, for the moment, the questions of sharpness and set, the determining factors will be those produced by the human element; that is, the speed of the saw, the manner in which it is held, the pressure against the wood being cut, and the length of stroke; this latter consideration being a joint consideration with the speed. Naturally, a man sawing adapts himself to the most easy and comfortable position, and also to the most convenient length of stroke, which is governed by his reach, or length of arm. The man having the greater arm length makes the best sawyer, generally speaking, simply because, while making the same number of strokes per minute as the shorter armed man, the length of the saw stroke, and consequently the speed at which the saw teeth pass over the work, is greater, and the right speed for the saw more nearly approached.

The cutting speed for wood is so high as to be unobtainable by any hand tool, but, as the workman approaches this speed, an improvement in the quality and quantity of the work becomes more and more apparent, and the softer the wood, the more important the speed factor becomes. This will account, to an extent, for some of the vagaries observed in sawed work, when the saw is known to be correct as to sharpness and set.

Consider, now, a piece of hard wood, say 2 in. thick. We know that the speed at which this material should be cut cannot be obtained by hand through rapid movement of the saw; but there we have an opportunity to interpose an offsetting condition by increasing the number of saw points which shall pass over the work in a given time. It is plain that if we use a five-point rip-saw, operated at a speed of "n" feet per minute, the number of cutting points passing through the wood in one minute will be 5n, and will remove a certain amount of wood. Now, if we increase the number of cutting points to 6, we can remove a greater amount of wood per minute.

It must be remembered that only a certain amount of wood can be removed in a given time; therefore, the depth of cut that can be produced in a stated time is in proportion to the width of the cut, and if a saw has too much set, even a slight amount in excess of that required, the width of the cut is increased and the depth of the cut is diminished, decreasing the efficiency of the saw, and making for slower and poorer work.

For this reason, the set of a saw should be as light as possible, and must be determined by the grade of wood being cut.

In rip-saws, the teeth per inch are 5, 5½, and 3. Finer points are not used because of "choking" due to the softer, spongy matter occurring between the "year growths" of the wood, caused by the diminished supply of cell-forming sap during the winter months when the tree was growing. This spongy matter varies, also, with the quality of the wood. In a rip-saw, then, for hard wood, we recommend a saw 28 in. long, having 5½ or 6 teeth-points per inch.

The quality of the work will be improved, and the saw will "hold up" longer if, after filing, the teeth are oil-stoned with a knife-edge oil-stone, passed over the teeth in the same manner as the file. For very thin wood a finer toothed saw is necessary, and especially so if the wood is soft, because the softer the wood, the softer is the spongy substance between the growths of the wood. In soft wood the saw teeth cut in more readily. The point is, then, to provide a saw that will have enough teeth in constant contact with the wood to prevent the teeth from "digging in" and so tearing.

In thick wood, several teeth are always in contact with the wood, even though the saw be of a coarse pitch. The net result of this is to form a bearing, so to speak, which permits each tooth coming into contact with the wood to enter straight and steady. On the other hand, if we use a coarse saw for thin wood, the one or two teeth resting on wood in the saw-cut, do not give a firm bearing. Each tooth reaches the wood in a sort of "jump," and jumps out again on the lower side, producing a series of blows, especially if the saw is at all dull; this will cause a tearing effect. For this reason it would be advisable in ripping thin wood to use a saw giving the best possible bearing continuously on the wood, say a saw having 6 points to the inch, and 26 to 28 in. long, for ripping thin wood of about ¼ in. The foregoing applies where accuracy and smoothness of cut are the first essentials.

Where quantity is the primary consideration, a coarser saw, say 4½ or 5 points to the inch may be used to advantage in the heavier wood. In hard woods, a little dullness of the saw can be tolerated, but in thin pieces, or in soft wood, the saw must be perfectly sharp, and finished with an oil stone.

A rip-saw for hard wood should be filed so the face of the teeth has a back slope of about 2 deg. and the back of the teeth should be filed to give an angle of 60 deg. with this face-angle. This produces a sturdy cutting point. In ripping soft wood, however, the face of the tooth may be concave a little; say a radius of ⅞ in. to 1 in. for a 5½ to 6-point saw, to give clearance, and to provide a more acute angle at the cutting point.

In cross-cutting, we are dealing with different problems, and have to consider an entirely different form of tooth. For this, the saw always has a greater number of points per inch than is necessary for a rip-saw; for, if we are cross-cutting hard wood, we have a harder cut than in ripping, and in cross-cutting soft wood the cut is far more wearing on the points of the teeth than is ripping. In addition to these considerations, if the saw becomes a little dull, especially in cutting soft wood, there is a tendency to pull the fibers of the wood out, rather than to cut them. Therefore, it is desirable to have a saw possessing a greater number of points to the inch in order that a larger number of these cutting points may pass over the wood in a given time. The wear is distributed over a greater area of metal in the saw, also the wood removed in cross-cutting has a better mixture of "spongy" matter and true fiber, so that there is less tendency to "choke," and the employment of a larger number of cutting points is practical.

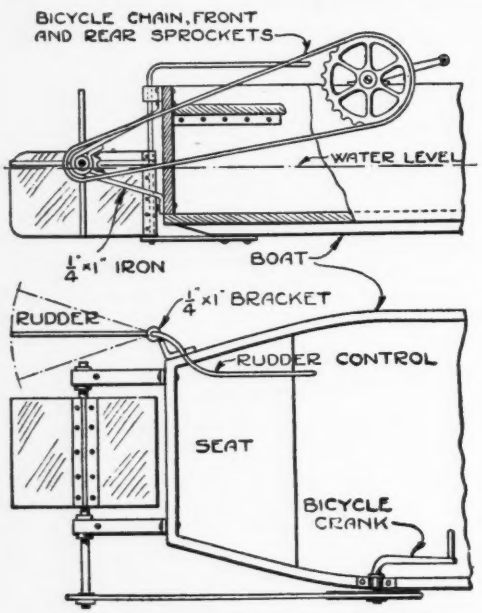
As in a rip-saw, if a close, smooth job is the object, a fine-toothed saw must be used, say 10 points to the inch for thick or hard wood, and 12 points to the inch for soft or thin wood. I would also advise that the 12 points to the inch be used for thin pieces of hard wood, while a panel saw may well be carried for extra-thin pieces of soft wood. This arrangement is calculated to economize in saws, and at the same time to give a set of the greatest efficiency. A cross-cut saw, also, should be well sharpened with an oil stone after filing, but in a very different way from the method used for rip-saws.

The method generally used in saw filing is to file from the edge of the tooth toward the back, away from the cutting edge. A better way is to file toward the front, or toward the cutting edge of the tooth. This

will produce a "wire edge" on the cutting edge. Now take a large, flat oil stone and place it on the side of the saw, passing it from the heel to the point of the saw, to remove the wire edge. A saw so treated will cut clean and true, for this will give a straight, sharp and true cutting edge. A saw as usually filed will show a ragged edge under the magnifying glass, and the cutting edge may even be a little rounded if the man who filed it was not very expert.—J. B. MURPHY.

A Handpower Paddle Wheel for a Rowboat

THERE are some persons who like a boat ride but do not take kindly to rowing with oars. For those having this disinclination the paddle wheel here shown was especially designed. A



Stern wheel propeller for a rowboat to drive it by turning a crank by hand

shaft supported with two brackets at the stern, and carrying a paddle wheel made of thin metal sheets into four divisions, has one end fitted with a small sprocket placed in line with a driving sprocket stationed on the gunwale just forward of the canoe seat. These sprockets, as well as the crank, may be secured from an old bicycle.

As the paddle wheel is located directly back of the boat it is necessary to change the rudder, which is shown set to one side in the illustration. Its bearing is attached to the side of the boat and the steering arm brought over near the canoeist's seat. The right hand is used to turn the crank and the left on the rudder arm. With this propeller a rowboat may be driven in shallow water as well as in midstream for the propeller blades do not extend below the keel.—P. P. AVERY.

Lumbering Dimensions for Figuring Quantity Wanted

ALL lumbermen talk in terms of board feet. A board foot is a piece of timber 12 in. long, 12 in. wide and 1 in. thick. This means that a block of timber 12 in. square on the ends and 1 ft. long would contain 12 board feet. Follow this simple rule: Multiply the end dimensions together and divide the product by 12 and then multiply by the length of the piece in feet. Thus, a 2 by 6-in. studding which is 16 ft. long contains:

$$\frac{2 \times 6}{12} \times 16 \text{ equals } 16 \text{ board feet.}$$

The table which follows gives the board measure per lineal foot for the different sizes of lumber that are ordinarily used on the farm:

1 by 4 in.	.....	.33	board ft.
1 by 6 "	.....	.50	" "
1 by 8 "	.....	.67	" "
1 by 10 "	.....	.83	" "
1 by 12 "	.....	1.00	" "
2 by 4 in.	.....	.67	board ft.
2 by 6 "	.....	1.00	" "
2 by 8 "	.....	1.33	" "
2 by 10 "	.....	1.67	" "
2 by 12 "	.....	2.00	" "

Make Due Allowance for Lapping

In covering walls, floors, ceilings, etc., with the common lumber stock it must be understood that 100 ft. of lumber will not cover 100 ft. of the surface, such as the floor or wall. It is necessary to add to the actual measurement of the surface to be covered so as to allow for the lapping of the boards or the matching. The amount to add varies with the different

kinds of stock as shown in the list which follows:

4 in. flooring.....	add	33	per cent.
6 in. flooring.....	"	20	" "
Horizontal sheathing	"	20	" "
Diagonal sheathing.	"	25	" "
Ship lap for walls...	"	20	" "
Lapsiding, 4½ in...	"	33	" "

The greater portion of the southern yellow pine lumber that is marketed in the United States is graded and classified in accordance with the rules of the manufacturers' association. It is customary to figure ¼ to ⅝ in. smaller sizes than those given for this sort of dimension lumber. For instance, a rough 2 by 4-in. studding will measure when dressed or surfaced 1⅝ by 3⅝ in. A 2 by 6-in. piece will measure 1⅜ by 5⅝ in. These measurements are for timber which is surfaced on one side and one edge designated (S1S1E). This is the ordinary size of "Yard Stock" which the farmer will purchase from his dealer. In case the timber is surfaced on all four sides a 2 by 4-in. piece will measure when dressed 1½ by 3½ in. and a 2 by 6-in. piece will measure 1½ by 5½ in. This should be remembered, for a piece may be selected too small for its intended purpose.

Price of Timber Sure to Increase

The annual per capita consumption of lumber in the United States is about five hundred board feet as compared with Germany's forty-eight board feet. Gradually we shall reach the German level. This will reduce the demand upon our remaining supply of timber and help make it sufficient for all legitimate needs. This does not imply, however, that there is a timber famine by any means. Up to now timber of all kinds has been cheap and abundant, but soon some kinds will be scarcer than others and some grades will be higher in price. There will be a great supply of the common grades of building lumber for many years. It is estimated that there are 2800 billion feet of standing timber against an average consumption of 50 billion feet a year. This will furnish cutting for 56 years at the present rate from the present stand. Natural reproduction or growth will add to this, while the annual consumption of timber will be much lessened.—W. E. FRUDDEN.

The Barber-Pole Aiming-Point Used in Artillery Firing

ALMOST all artillery firing practice in the present war has been done with the use of an aiming pole. This is a device which enables the gunners to get an angle of deflection so that they can lay their guns on a target without seeing it. There are but few designs for these poles. The red and white pole, painted in effect similar to that of a barber pole and reinforced at one end with a spike so that it may be thrust into the ground, is about the newest design. Red and white are the most contrasting colors and are among those most easily visible in all kinds of weather. The poles are placed about 50 yards from the guns. The farther away the aiming point the better.

Aiming pole painted like barber pole

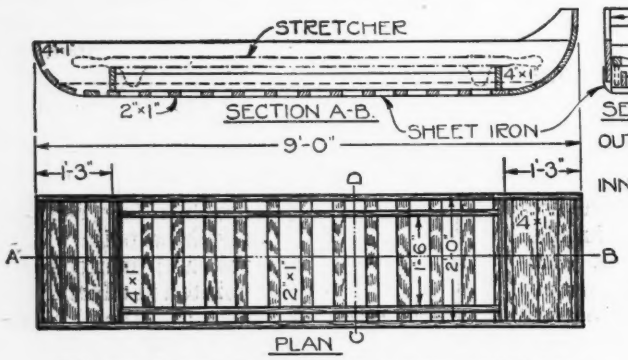
Poles of this kind may be easily made and painted like a barber pole by wrapping a piece of paper around the body of the pole in a spiral form, leaving a part uncovered, which may be painted; then, when it becomes dry, the other uncovered portion may be painted.—DUDLEY HESS.

Using Molten Lead Safely in a Damp Mold

MANY mechanics have had their patience sorely tried when pouring lead around a wet or damp joint, to have it explode, or scatter from the steam generated by the heat of the lead. This blowing may be avoided by putting a small piece of resin into the ladle and permitting it to melt before pouring the lead.

Tobogganing Over Flanders Mud in a Mud-Toboggan

THOSE of our readers who live in the northern states and Canada are quite familiar with the carrying power of the Canadian toboggan on soft snow; but the idea of a similar vehicle for negotiating mud will probably sound rather bizarre to them. In spite of this, such things do really exist. They are still another result of the topsy-turveydom which the war has created.



This mud-toboggan was made to rescue soldiers in Flanders where wheeled vehicles could not be used

It was found that wheeled traffic was oftentimes impracticable in the field of operations "over there" on account of the all-pervading mud, and so the officers cast about to improvise a means of getting around the difficulty. The novel mud-toboggan illustrated is the result. It has an iron bottom with wooden gunwales, and is practically spoon-shaped. It had to have a very low center of gravity to avoid overturning on uneven ground, and the sides were necessary to keep out the mud. The whole structure is streamlined in long curves so as to give the least possible resistance to traction.

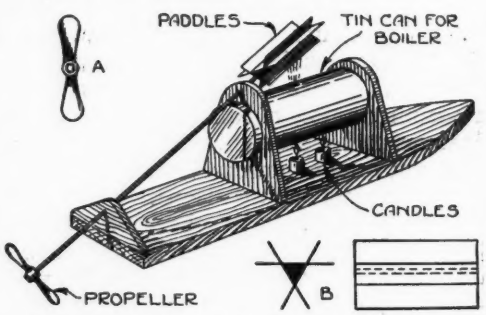
The vehicle is designed primarily to carry a stretcher, and this rests on two blocks of wood in the bottom of the toboggan, thus using the weight of the occupant to steady the vehicle without allowing him to touch the bottom or detracting from his comfort. It will carry one stretcher or 200 lb. of supplies.

Such a toboggan could be made use of for many like purposes where the ground is so soft that a wagon would get stuck in it.

A Toy Boat with Steam-Boiler That Turns a Propeller

THE boiler for this steamboat is a baking-powder can held in a horizontal position between two upright standards 3 in. from the base board of the boat. Under this can three candles are placed. In the upper part of the can, and 1 in. to one side of the center, a small hole should be made with a nail. The boiler should be filled two-thirds full before candles are lighted and the top must be soldered on. Future filling can be done through the small hole in top of the can.

The propeller is constructed as shown at *A* and fastened on to a stiff wire shaft as shown in the illustration. This shaft is held in an inclined position by means of two standards and the end which comes over the boiler has the paddles. Construction of the paddles is shown at *B*, the center being a triangular stick of wood three inches long with its faces one-half an inch. Upon this the tin leaves of the paddles are nailed.



The force of the escaping steam striking the paddles turns the propeller shaft

When the water in the boiler begins to boil the steam will burst out through the hole in the top of the boiler. This steam strikes against the leaves of the paddles and turns the shaft, which will propel the boat about in the water. The base of the boat may be of any desired shape.

A Drop—and You Have a Microscope

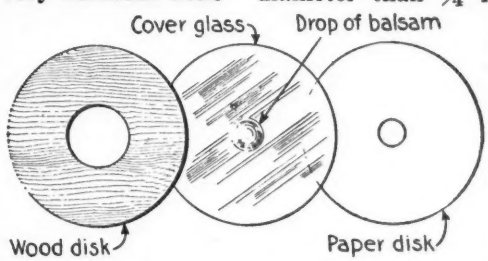
Making a high-power magnifier with a drop of Canada Balsam

By W. S. Standiford

WHILE almost every one has heard of the wonderful powers of the microscope, yet but few have ever had an opportunity to look through a high-powered one. Fewer still have been able to possess a really good instrument. The high price of the instrument will always prevent its common use, for a serviceable microscope cannot be purchased for less than $25, while the more expensive ones cost several hundreds of dollars. And yet a very excellent little microscope may be made at home in a few minutes by any one and at a cost next to nothing.

First of all, purchase a small quantity of Canada balsam and a dozen cover glasses from some dealer in optical goods. These cover glasses, as they are called, are used in mounting objects for the microscope. They are about as large around as a penny and as thin as a sheet of writing paper. This is all you need to purchase and the outlay should amount to only a few cents. Any one who has noticed how water spilled on a tablecloth magnifies the fibers of the cloth will understand the principle upon which these lenses are to be constructed, only we shall use the Canada balsam instead of water.

To make a microscope, take a clean cover glass and in the center place a small drop of balsam. Your microscope is now complete; that is, the part that does the magnifying is finished. It is therefore very important that this part should be well done. It is best to use a common ordinary steel needle for placing the drop of balsam on the cover glass. Dip it well into the balsam. On raising it you will find that the balsam runs slowly down to the point, very much as molasses would. The drop thus formed should be placed carefully in position in the center of the glass, and great care must be taken to make it exactly round. A number of these microscopes should be made of different sizes. Each one will then have a different magnifying power, the rule being that the smaller the drop, the more it will magnify. As it is difficult to make a nicely shaped large drop, it is best not to attempt one of a greater diameter than ¼ in. The large drops should be allowed to harden for a time before use. If the first drop is not perfect, clean the cover glass with a little benzine, and try again.



A cover glass, a wood and a paper disk make up the main parts of the microscope

The microscope as thus made, can be used just as it is, but it is best for ease in working to have some kind of a mounting. A very good mounting may be made as follows: In a piece of paper the size of the cover glass, cut a small circular hole, not quite as large as the drop of balsam. Paste this on the reverse side of the cover opposite the drop. This forms what is called a "diaphragm," and prevents the light from the edges of the drop from interfering with the accurate working of the lens. Next make a small circle of thin wood, and in the center of it bore a hole a little larger than the drop. Gum the cover glass on this so that the drop will come on the inside. Thus you will not only be able to handle the delicate cover glass freely, but you will also protect the drop from dirt and from the effects of handling while it is hardening.

After the microscope is made, the next question is how to use it. For examining mounted transparent objects or slides, it may be used like an ordinary magnifying glass. Hold the slide up toward the

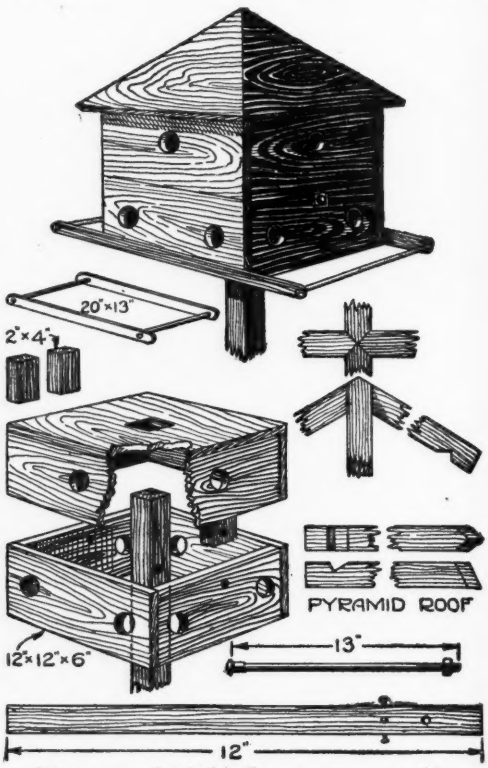
light. As the distance between the object and the lens for a clear definition—or focus—of the lens of all these microscopes is very short, the microscope should be placed against the slide and then moved slowly away until the proper focus is reached. The eye should be placed very close to the lens.

If you wish to examine the water animalcules, as they are called, use the following simple device. Take a plain slide from common window glass, about 3 in. long and 1 in. wide. On its center place a cell or round ring of wax, small enough to be covered with one of the circular glass covers and deep enough to contain a good-sized drop of water. This slide will answer all the purposes of a store-made affair costing two dollars or more. To use it, put the drop of water that you wish to examine in the wax cell and drop a cover glass upon it, thus flattening the curved surface of the drop, so that it may be examined without the image being distorted thereby. The slide may be viewed just like any mounted object.

The magnifying power, as has been said, varies with the size of the drop of balsam used. A drop ¼ in. in diameter will magnify to about 15-diameters; a drop half that size about 30-diameters, while powers of one, two or even three hundred diameters may be readily obtained. When it is realized that the ordinary pocket lens rarely magnifies more than 5 diameters, an idea of the immense powers of these microscopes will be arrived at. In examining pond water, however, only the lower powers should be used. Use the lowest first and increase the power until the best results are reached.

Making a Take-Down Birdhouse for Cleaning

BIRD conservation received a great impetus last year owing to the interest taken by the leaders of great organizations, and thousands of bird houses were erected in parks and nearby woods. After one season's use by feathered tenants a domicile, however carefully designed, is practically useless until it is thoroughly cleaned, which is well-nigh impossible when ordinary lines of construction are followed. The illustration shows a very simple birdhouse built with the idea of being taken down and cleaned regularly. It consists of a box made in two parts. On the inside of the upper portion cleats are fastened and extend down over the edge. Holes are bored ½ in. in diameter in the projecting ends

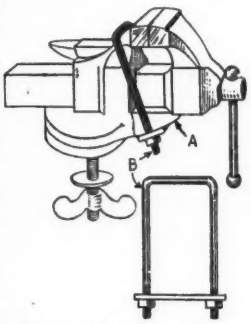


The parts of this birdhouse are separable so that it may be taken apart and cleaned

and the ½-in. bolt passes through them and locks the parts together immovably. The same bolt also extends through a hole in the upright post. The perch frame is separately made and nailed to the bottom of the house. The pyramidal roof is laid out as shown and permanently nailed to the upper part of the box. To clean the house or take it down it is only necessary to remove the nut, withdraw the bolt, and lift off the sections. All inside surfaces should be washed out and exposed to sunlight for several days before again setting up the house. Only a yearly renovation is contemplated by the design given. There is nothing, however, to prevent a more frequent clean-up.

Mending a Broken Vise with a Clamp

A CARELESS workman using a bench vise for an anvil broke away a part of the base, as shown at *A*. This let the sliding jaw sag, putting the tool out of commission. The broken piece was clamped in place by the saddle clip *B*, and the vise worked as well as ever. The clip was forged from a machine steel rod with a rectangular cross piece of the same material held with nuts.—T. H. LINTHICUM.

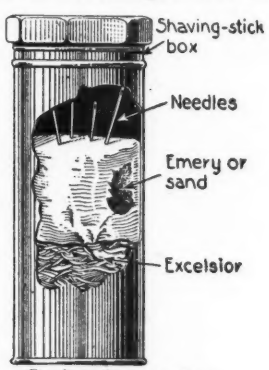


The saddle clip shape and how it was used

A Safe Case for Holding Needles Cleanly Without Rust

NEEDLES are so commonplace that the inherent danger in their use often is not brought forcibly to mind until an accident occurs. A needle, carelessly dropped on the floor, is a menace to the bare or stockinged feet of children and adults, and a needle, if broken in the foot, may lead to serious consequences.

In the accompanying illustration is shown a convenient needle case, that any boy easily can construct for his mother or sister. The materials required are an empty metal box, such as shaving soap is sold in, a piece of worsted, or other cloth of an elastic nature about 5 or 6 in. square, and small quantities of excelsior and emery, or fine sand. Approximately a heaping tablespoonful of the emery or sand is tied in the piece of cloth and the excelsior and emery inserted in the box in the order named, as illustrated. If a small quantity of glue is smeared on the inside of the box, its contents, when inserted, will be securely held in position. If mother has this handy case, she will not be tempted to stick her needle in the window curtain and, moreover, the emery will keep her needles scoured clean.—C. J. BRICKETT.

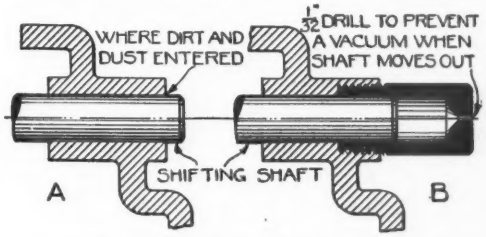


Inclosed emery bag to protect needles

Preventing Dirt from Entering a Shifting Shaft Bearing

TROUBLE often occurs when shifting the gears of an automobile. In many cases the difficulty can be traced to such cause as shown in the accompanying Illustration.

The part at *A* illustrates the manner in which grit and dust may readily work their way inside the gear case. The constant movement of this foreign matter rubbing against the aluminum case and the steel shaft in time prevents smooth action of the latter when the gears are being shifted.



A supplemented piece of steel used as a cap to prevent dust entering the bearing

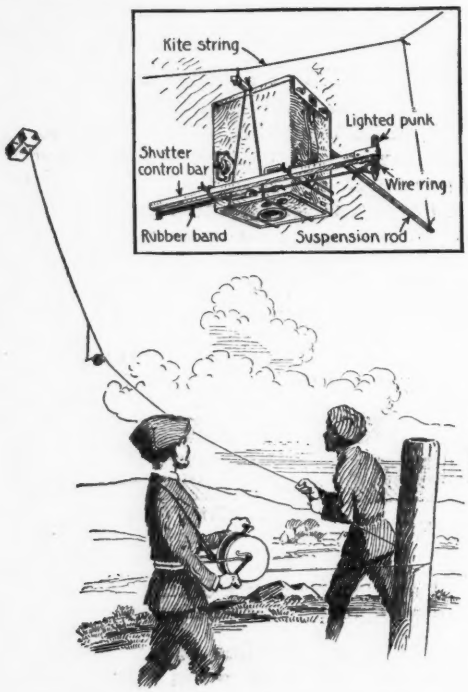
The repair may be made by providing a piece of steel rod, bored out to a diameter a trifle larger than that of the shifting shaft, and to such depth as to enable the shaft to move the proper distance. The added piece, as shown at *B* in the foregoing diagram, is fastened through the medium of a thread.—ADOLPH KLEIN.

Tightening the Cane in the Bottom of a Chair

CANE chair bottoms will, in time, sag in the middle and the cane will eventually break out at the edges. To tighten the seat proceed as follows: Turn the chair bottom upwards and rub the cane thoroughly with hot water until it is well soaked. Should it be dirty, use a little soap. Let it dry in the air and it will be as tight and firm as when purchased.

Aerial Photography with a Box Camera Held Up by a Kite

WHILE the photographs are not as clear as those required on the battle front in Europe, very interesting pictures of limited areas may be made, automatically, from considerable elevations with a small box camera suspended from a large kite in the following manner.



Attaching a box camera to a kite line for using it to take aerial photographs

A shutter-control bar of white pine is wired to the camera in the position shown in the detail. One end of this bar supports, in a sheet metal holder, a piece of ordinary "punk" such as is used to light Fourth of July fire-crackers, and the opposite end has a wire nail projecting downward from it. The shutter operating lever of the camera is then provided with a double-end wire loop which is passed through a small hole previously drilled in the lever.

The camera having been loaded, the shutter-lever is held in its set position, ready to make a "snap-shot" by means of a cord, which is attached by one end to the wire loop, and by its other end to a small wire ring which is passed over the piece of "punk," as shown. A rubber band is then stretched from the opposite wire loop to the wire nail, the refractive force of the rubber band being now supported by the piece of "punk."

The camera having now been attached to the kite string, as shown, the piece of "punk" is adjusted downward at a distance proportional to the pre-determined time at which the "snap-shot" is to be taken. The punk is then lighted.

The kite string is now payed out a sufficient distance to raise the kite, bearing the camera with it, to the desired elevation and it is then held in position a sufficient period to permit the "punk" to burn upward to the position of the wire ring, at which time the ring, by reason of the pull of the rubber band thereon, cuts through the ashes and allows the shutter-lever to operate to make the "snap-shot." The kite is then pulled down far enough to reach the camera, when a fresh film may be reeled off, and the "punk" and the shutter re-set for another exposure.

The photographs secured in this novel manner may be made more interesting by having enlargements made from them.

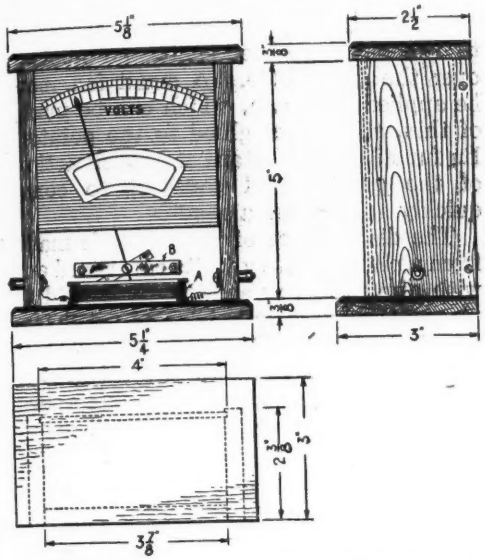
A Bicycle Pump to Clear a Drain Pipe

WAR demands make plumbers scarce and for this reason a residence owner had to clear his own water drain pipe. To do so he had to make some sort of a force pump, and he selected a bicycle pump for the purpose. The rubber hose was detached and the hole plugged. The entire bottom section was removed, leaving the end of the cylinder open. A large hollow rubber ball, having a larger diameter than the drain opening was procured, and cut in half. The center of one-half was cut out to make it fit tightly over the pump end. It was further secured by a few turns of fine wire.

This arrangement made a large syringe with the lower end cupped downward. The sink was filled with a strong solution of lye and hot water. Using the pump as a large syringe over the drain opening, the solution was forced into the pipe and it was cleaned neatly and quickly.—M. M. CLEMENT.

How to Construct a Voltmeter for Experimental Work

THE first essential of a good, substantial, portable voltmeter is a case in which to inclose the working parts. Such a case is dimensioned in the illustration. The side walls, top, bottom and back are preferably made of oak for



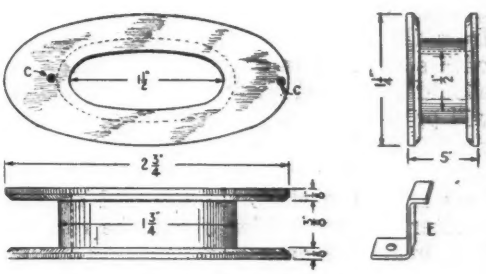
The case is made of oak held together with screws to inclose the working parts

durability and appearance. The whole case is joined together with screws put into small drilled holes that are countersunk to prevent splitting the wood. The front is of glass placed into small grooves like a sliding cover to a box.

All voltmeters, with the exception of the chemical types, have one or more coils of some type or other. In this voltmeter the coil is located at *A*. The coil has no metallic core and is wound on a spool shaped as shown from a piece of soft pine. It has a hollow center to allow for the movement in the frame *B*. The dimensions given for this spool may be altered to suit requirements.

When the spool is complete, drill a small hole through the side wall as shown at *C* for one end of the wire. In winding this coil use No. 34 or 36-gage wire. The finer the wire in the coil, the more turns can be put on it, and the more turns of wire the more sensitive voltmeter. This statement is true within a certain limit; for when the outside turns on the coil become so long that their resistance overbalances their magnetic effect, then extra turns will be of no use. The spool should be wound full. When starting to wind the coil it is a good plan to run a piece of somewhat larger flexible wire through the hole at *C* and then solder the fine wire to this on the inside, insulating the joint with thin paper. This plan is recommended; for if the fine wire is run through the hole on the outside it is apt to break off and will cause trouble in making the connection. The coil may be wound in either direction. The end of the wire from the outside coil should be run through the small hole at *D*. To give the two ends of the coil an appearance of uniformity a larger piece of flexible wire may be run through this hole and soldered to the fine wire on the inside. When the coil is finished it should be completely immersed in hot paraffin for about one minute. This coating of paraffin makes the coil moisture-proof and protects the insulation. The coil is then mounted in the center of the base of the voltmeter case by means of two small clamps shown at *E*. Connection is made from the two ends of the coil to the two binding-posts on the side of the case.

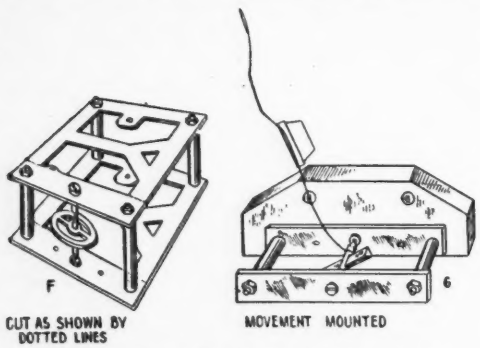
It is now necessary to have a moving part operated by the magnetism set up by the coil to register the voltage. The delicacy of the instrument depends greatly on the freedom with which this part of



The dimensions of the spool which is made of soft pine without a metal core. Extra fine wire is used for the coil

the voltmeter may be moved, therefore friction must be reduced as low as possible. A pivot-bearing is very practicable and is easily obtained from the works of an old alarm clock. Cut off the ends of the

frame as shown by the dotted line in *F*, leaving the two corner posts which hold the strips together with the balance wheel bearings. The rough corners and edges caused by the cutting should be removed with a file. Two small holes are then drilled in the brass strip which holds



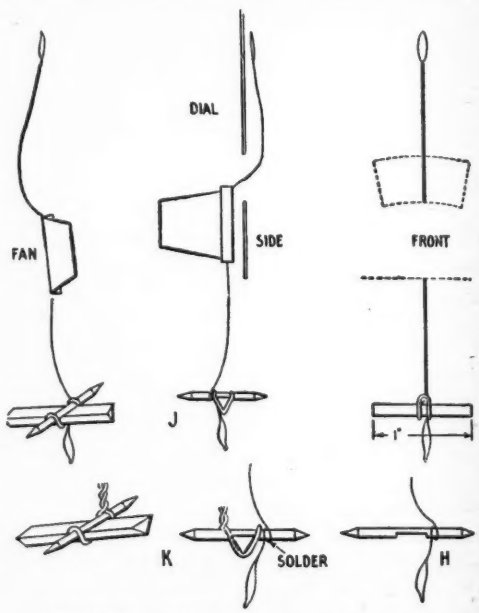
Part of the works of an old alarm clock is used for the necessary pivot bearings

the fixed bearing of the balance wheel, one on each side of the bearing, half way between it and the posts which hold the frame together. These holes are used to fasten the frame with small screws to a block as shown at *G*. This block in turn is screwed to the back of the case.

Obtain the balance wheel from the old clock and carefully remove it from its shaft, taking care not to bend the shaft or batter its points. The next thing to make is the pointer or hand for the voltmeter. A piece of brass or copper wire about 6 in. long of No. 22 or 24 gage is used. About 5 in. from one end make a close turn around the balance-wheel shaft ¼ in. from the center as at *H* and fasten it with solder. The short end of the wire should be turned back on itself so that it will project about ⅜ or ½ in. below the shaft. After the pointer has been bent into shape and cut off so that it is 4 in. long from the shaft to the end of the pointer, enough solder should be run on it to make it balance. The shape of the pointer and its relative position to the dial or face of the voltmeter may be seen in *J*.

The shaft is then flattened on one side with a file as shown at *H*. This is to fasten a permanent magnet made of a three-cornered file. The file is ground smooth and charged by holding it across the poles of a permanent magnet, or better still, across the poles of an electromagnet. The magnet is then mounted temporarily at *K* and soldered, using an alcohol flame, after which the holding wire is removed. Owing to the pointer being perfectly balanced it will stand at the center of the scale when there is no current in the coil. To bring the upper end to zero it is necessary to have a light spring attached. This can be made of a coil of light spring brass wire attached to the balance-wheel shaft and hooked over the frame side. A small fan may be applied as shown, which can be made of thin, stiff paper glued to the pointer. Its function is to retard the quick action of the pointer and cause it to come quickly to rest for a reading.

The dial or face of the meter is made from a piece of heavy white cardboard cut with dimensions as shown. It is held in place with two small strips of wood fastened to the side of the case. The scale is put on after it is in place. Adjustment of the light spring and weight should be such that the pointer comes to rest at about



The shaft or pivot with its cardboard fan and pointer for the dial of the voltmeter

¼ in. from the extreme left side of the dial. This is the zero point which permits the pointer ¼ in. freedom from the start. This is to detect a current passing through in the wrong direction.

It is now necessary to calibrate the dial, and to do this properly a commercial voltmeter must be obtained. One of these can be borrowed for the purpose. The terminals of the coil are connected in series with the voltmeter and a cell or battery. While it is not necessary to use a large resistance in connection with the work it will make the calibration more convenient. If it is used, it should be large enough to vary the current obtained from the batteries so that a difference of about ¾ volt is registered by the commercial voltmeter. Then when one cell is connected, the resistance is adjusted until the commercial voltmeter registers exactly one volt. The position of the pointer on our home-made meter will register one valt wherever the pointer comes to rest. It is so marked; then two cells are connected in the place of one, and the resistance adjusted until two volts are registered on the commercial voltmeter. Where the pointer comes to rest on the new one, mark it two volts, and so on until the dial is completely calibated.

If an ammeter is desired instead of a voltmeter, exactly the same procedure may be followed, except that the coil on the spool should be wound with from two to four turns of large wire such as No. 14 or 12 copper magnet wire. The fewer the turns of large wire the higher will be the amperage capacity of the instrument.

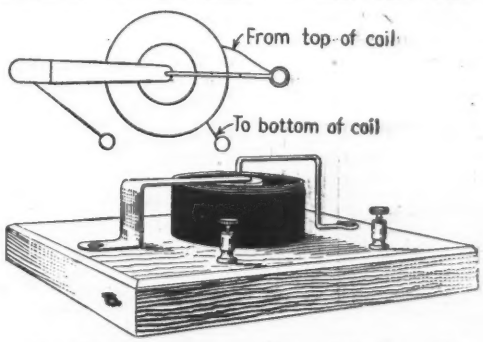
A combination volt-ammeter may be made from this instrument by first winding about three turns of heavy magnet wire on the spool, then winding the rest of the space with fine wire, taking care to wind the fine wire in the same direction as the heavy wire. Connect one end of the fine and the corresponding end of the large wire together under one binding-post. Then connect the other end of the fine wire to another binding-post, and the other end of the large wire to still another binding-post. Mark the binding-post to which both the fine and large wire are connected "*C*" for common, that is, common to both ammeter and voltmeter. Mark the post to which the fine wire is connected "*V*" for voltmeter, and the post to which the heavy wire is connected "*A*" for ammeter.

When testing volts, connect one side of the circuit to be tested to the post marked "*C*," the other side to the one marked "*V*". When testing the amperage in a circuit, connect one wire to the post marked "*C*" and one to the post marked "*A*". In either case, if the pointer starts the wrong way, reverse the connection. The calibration is made in the same way as for the voltmeter, except that a commercial ammeter is used. If a combination colt-ammeter is being calibrated, the readings in volts may be put above the scale and the readings in amperes placed below, or *vice versa*.

When using the instrument it must be remembered that the principal part of the movement is a small permanent magnet and that it will be affected by an electric magnet force from without the instrument itself. This being the case, the instrument should be kept away from any outside source of magnetism, as for instance, an electric coil, or electric motor, or dynamo generator, or any kind of a permanent magnet.—BERT RODSON.

An Old Telephone Receiver Made Into a Buzzer

AN old receiver that has lost its magnetism can be easily made into a buzzer, as shown in the illustration. Make a base of wood and fasten the receiver to it with screws. The cap and diaphragm is not used. A strip of metal —steel, not brass—is bent as shown and fastened to the base so that its over-



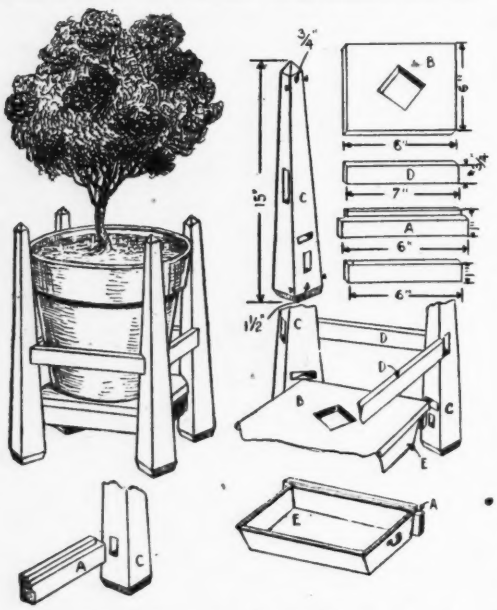
An old telephone receiver with its coil mounted on a wood base to make a buzzer

hanging end will be close to the end of the magnet core. On the opposite side of the receiver make a similar shaped piece from a length of brass wire and fasten it to the base also. The overhanging end of this piece should be close to the overhanging end of the steel piece.

One end of the coil is connected to one binding post and the other is connected to the screw holding the brass piece to the base. The steel strip is connected to the other binding post. Slight bending of the overhanging ends of the brass and steel pieces will adjust their working points and make them buzz when the current is turned on the circuit. With a one- or two-cell battery in the line, and a push button or key, an efficient buzzer will be the result.—THOMAS MILLSPAUGH.

A Convenient Stand for a Heavy Potted Plant

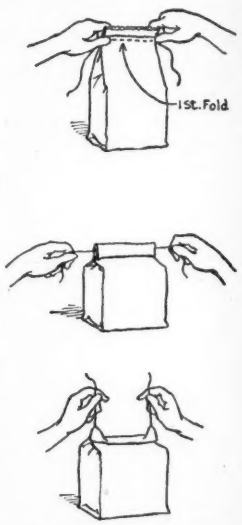
THE sketch shows a tabouret or stand of strong and simple design to hold a flower pot. The tapered posts are 1½ in. square at the base and taper to ¾ in. at the top and are 15 in. long. Each part is shown with dimensions for making the stand. Cypress, white and yellow pine are the best woods to use. Under the shelf on which the pot rests are two rails having runners as shown at *A*. Upon them the drip pan rests or hangs with its upper edge or flange in the rabbet. It is easily slid in or withdrawn to be emptied and makes the stand convenient for indoor use. The hole in the bottom of the flower pot is placed directly over the hole in the shelf *B*. This permits the seepage to pass through to the pan. Two coats of weathered oak or green stain and two of wax make a suitable and durable finish for the wood parts.—H. ADLON.



Details of the parts for making a stand in wood to hold a heavy potted plant

A Saving of Time and Twine in Tying Bags

A VERY clever method of tying a bag that will result in economy of twine and also of time is deserving of being better known. The old method required enough string to encircle the parcel two or three times before it was held securely and that needed from 20 to 36 in. of string for a moderately small package.



Folding the bag top over the tying string

The new method is as follows: Close the bag according to the old method. In the first fold place the string and fold as often as is necessary after that to adequately close the bag. The corners are then turned toward the center and flattened. This brings the two ends of the string together to be tied. The finished package is neat and firmly tied, presenting a pleasing appearance, and what is unusual, only four or five inches of the string is required to make the tie.—EMILE PARENT.

Repairing Leaks in Aluminum Ware with Rivets

IT takes more than average experience to repair a leak in aluminum ware by soldering. An easy method of effectively repairing small leaks is to ream out the hole to a diameter that will accommodate a piece of aluminum wire. A short piece is passed through the hole and riveted in place with a hammer until the surface of the metal is practically smooth. If aluminum wire cannot be obtained, a piece of soft copper wire or wire solder will answer the purpose.

Electrical Devices and How They Work

VIII.—Principles of direct current dynamos

By Peter J. M. Clute, B. E.

A DYNAMO-ELECTRIC generator is a machine for converting mechanical energy into electrical energy; in other words, it generates electric current when driven by mechanical power. The term "dynamo-electric generator" is so long that it is usually abbreviated into "dynamo," which bears the same meaning. The name "generator" is commonly used when the machine generates electricity, in order to distinguish it from the "motor," which is also a dynamo-electric machine.

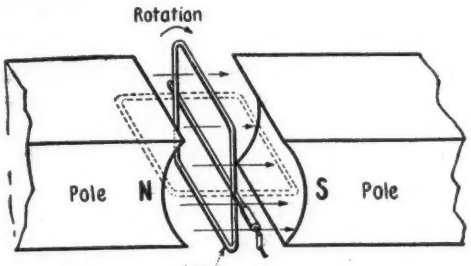


Fig.1

An ideal method of dynamo construction with two poles and revolving armature

An electric motor converts electrical energy into mechanical power; or, rather, it produces mechanical power when supplied with electric current. A dynamotor, motor-dynamo, or motor-generator, is, as its name implies, a combination of the two machines, and consists of a motor and a generator, either directly coupled together or built as one machine. It is used to transform electrical energy at a certain potential into energy at a higher or lower voltage, with a corresponding decrease or increase in amperage. When used to convert direct into alternating currents, or the reverse, a single armature winding usually performs both motor and generator functions, in which case the machine is called a "rotary converter."

The dynamo is based on the discovery that an electric current is generated in a conductor by moving it in a magnetic field. The electric motor works on the principle that a conductor carrying a current in a magnetic field tends to move. Thus they are exactly the reverse of each other in action.

The two machines are, however, very similar in construction. In fact, the same machine can be used equally well for either purpose. They are generally made slightly different, but this is only done to adapt them more definitely to certain needs.

It has been stated that both generator and motor depend for their action upon the movement of conductors in magnetic fields. Experience has proved that the best way to carry out this principle is to arrange the conductors in suitable form and rotate them between the poles of a magnet, or magnets, permanent or electrically excited.

Every D. C. dynamo consists of three essential parts: (*A*) The field magnet to produce a powerful magnetic field; (*b*) the armature, consisting of an iron core on which is wound a system of conductors, revolving in the magnetic field in such a way that the number of lines of force cutting the conductors varies continuously; (*C*) the commutator, and brushes, for giving a uniform direction to the alternating currents in the coils by their rotation in the magnetic field.

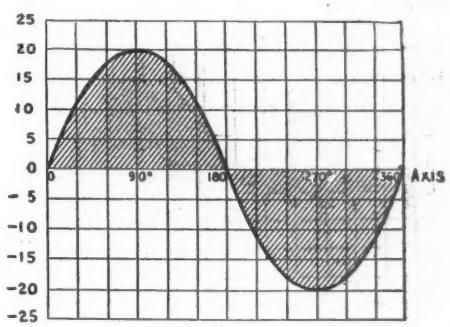


Fig.2

A curve of the electro-motive force of an ideal and simple electric dynamo

In the consideration of the underlying principles of the electric generator, it will be found convenient to consider a single conductor in the form of a loop, revolving between two magnet poles

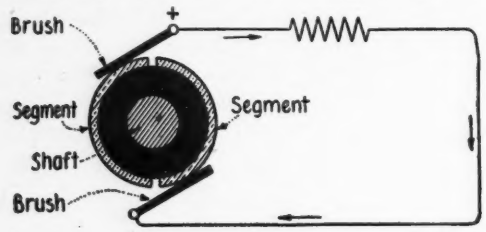


Fig.3

When the armature-coil is simple the commutator consists of only two parts or a split tube

about a horizontal axis in the direction of the arrow, as in Fig. 1. In the position shown, the loop encloses the maximum flux or lines of force, but since there is no change in the flux enclosed, the induced E. M. F. is zero. By rotating the loop a quarter-turn, its plane will be parallel to the direction of the lines of force, as shown by the dotted lines, and consequently no flux will pass through it. In rotating through this quarter-turn, the decrease in flux threading through the loop generates in it a direct E. M. F., whose direction is indicated on the loop by arrows.

In the next quarter turn, there is an increase in the lines of force through the loop, but since the loop has turned over, the flux passes through it in the opposite direction. This is practically equivalent

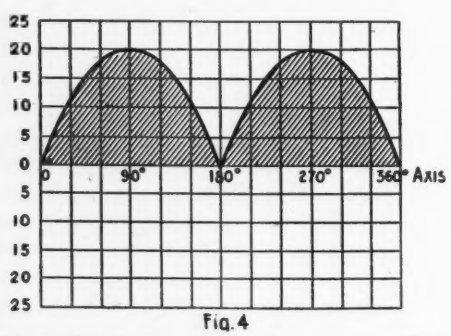


Fig.4

Rectified electro-motive force curve of a simple dynamo with a two-part commutator

to a steady decrease in the original direction and thus the E. M. F. induced in the loop is in the same direction for the entire half-turn. When the half-turn is completed, the value of induced E. M. F. is again zero; and if the loop be further revolved, the E. M. F. is induced in the opposite direction, around the loop. If there are several turns in the loop, the induced E. M. F. reverses in all of them twice every revolution.

The curve in Fig. 2 shows the induced E. M. F. in such a case, where the coil rotates with uniform speed. The curve starts with coil in a vertical plane, the abscissa at any point is the angle through which the coil has moved, and the corresponding E. M. F. is the ordinate, drawn above the horizontal in one direction, and below when it is reversed. Thus, when the plane of the coil has revolved 45 deg. the induced E. M. F. is about 15 volts, and 90 deg., 20 volts, etc.

The current produced is what is termed an alternating current and goes through a complete cycle of changes for one revolu-

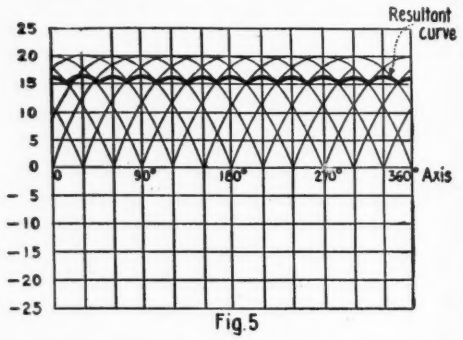


Fig.5

With numerous coils and commutator bars a direct constant current is obtained

tion of the armature. To convert these alternating currents flowing in the armature into a uni-directional current in the external circuit, a commutator is employed. It works on the principle that if the connections of the armature coils are reversed at the instant when the current in the coils is reversed, the induced currents will all flow in the same direction through the external circuit.

For a single armature coil, the commutator consists only of two parts. It is a split tube with the two halves or segments insulated from the shaft by a bushing of insulating material and are separated from each other as in Fig. 3. The ends of the coil, shown in Fig. 1, are connected with the two segments. Two brushes, to which the external circuit is connected, bear on the commutator, being so placed

as to make contact with the two commutator segments at the instant the current reverses in the cog. Thus one of the brushes is always positive and the other negative, and current circulates in the external circuit from positive brush back to negative, and thence through the coil again to the positive. With a single coil the current is pulsating, or falls to zero twice every revolution (Fig. 4). If, however, as in practice, a large number of coils are placed around the armature core and connected with separate commutator bars similarly as before, there will be obtained a series of successive composite pulsating currents, whose effective value approximate a constant current, as shown graphically in Fig. 5.

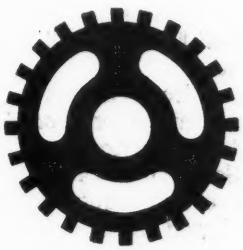


Fig 6

A typical armature punching made of soft iron

For D. C. generators, the most common form of armature is the drum armature. The core is made up of thin disks stamped out with teeth around the periphery. Figure 6 shows one of these armature laminations. The armature core should be laminated; this is done, because if the core were made of one solid piece of iron, it would have useless eddy, or Foucault, currents generated in it, which would waste a great deal of the power of the machine.

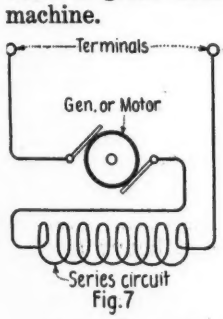


Fig.7

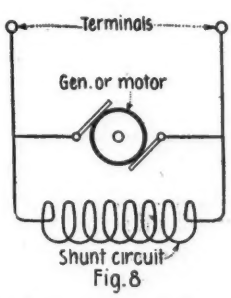


Fig.8

Diagrams showing one for a series winding and the other for a shunt winding

When assembled on the shaft, the slots form grooves in which the armature windings are placed. The armature coils may all be joined in series, and the common junctions connected with respective commutator segments. The E. M. F. generated in the armature depends on three factors: the number of lines of force cutting the armature coils, the number of revolutions which the armature makes per second, and the number of coils composing the winding.

The magnetic field in which the armature revolves is produced by large electromagnets generally excited by the armature current. When the entire current is led around the field coils, the dynamo is said to be series wound (Fig. 7). When the field is excited by coils of many turns of fine wire connected as a shunt to the external circuit, the machine is said to be shunt wound (Fig. 8). A combination of these two methods of excitation is called compound winding (Fig. 9). When the magnetizing current is supplied from an outside source the dynamo is said to be separately excited (Fig. 10).

In the series-wound generator, the whole armature current passes around the field magnets and through the external circuit. Any resistance put in the external circuit, causing the current to diminish, weakens the magnetic field and therefore decreases the E. M. F. of the machine. When there is no current flowing, its E. M. F. is zero except for the residual magnetism.

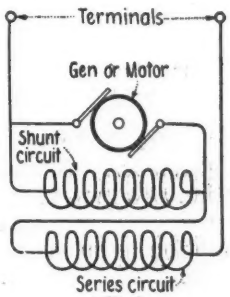


Fig.9

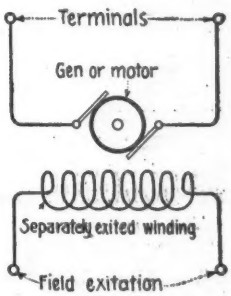


Fig. 10

The first is for compound winding and the second is a separately excited field

In the shunt arrangement the armature current is divided, part flowing around the magnets and part to the external circuit. In order that but a small current may be taken for the magnet, it is wound with many turns of fine wire. The current through the shunt coil depends only on its resistance and on the potential difference at the brushes. Hence it is constant and the magnet strength is con-

stant as long as the potential difference remains the same. The E. M. F. of such a machine is nearly constant, but is slightly greater when no current flows in the external circuit, for with increasing external current there is more current

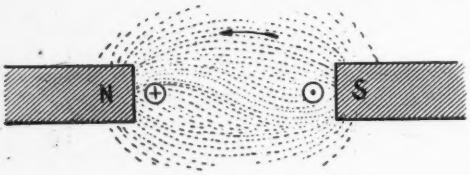


Fig. 11

Distortion of a magnetic field by a current carrying loop tending to turn it counter-clockwise

and a greater fall of potential in the armature itself.

Compound winding is a combination of the series and shunt arrangements. In this way, a dynamo may be made to maintain a nearly constant potential at the terminals, though the external current may vary greatly; or it may be over-compounded so that its terminal E. M. F. may be greater with large currents than with small.

Thus far, we have considered the ideal simple dynamo as a generator. Let us now consider its operation as a motor.

An electric motor is a machine in which electric current gives motion to an armature, this producing mechanical work. The D. C. motor is constructed in the same manner as a generator; in fact, any D. C. generator may be used as a motor. A study of the magnetic field resulting from the interaction of the field due to the field magnet and that of a single loop carrying a current will make it clear that such a loop has a tendency to rotate. Figure 11 shows the field distortion between magnet poles caused by a current passing through a loop of wire in the magnetic field. Many of the lines of force pass through the loop instead of passing directly across from one magnetic pole to another. As is well known, lines of magnetic force are under tension and tend to straighten out. In doing so, a magnetic stress is brought to bear on the current-carrying loop and tends to turn it counter-clockwise in the case shown in Fig. 11. If this magnetic effect is allowed to come into play, the loop will become the armature of a simple motor, and mechanical work will have been accomplished by the machine through the medium of the electric energy flowing through it. If, however, the loop is forcibly rotated clockwise by mechanical means, it will turn against the magnetic effort acting upon it, and work will be done against this magnetic stress. The loop will then act as the armature of a generator.

Direct current motors, like generators, are either series or shunt wound according to the service for which they are designed. Series motors are used where variable speed is required; shunt motors are employed where constant speed is desirable. High-speed motors are usually bi-polar; motors for slow-speed service have multi-polar fields.

The turning moment, or torque, of a motor is dependent upon the strength of the magnetic field and upon the armature current. In a shunt motor, the torque

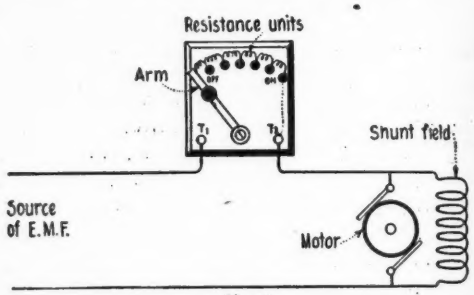


Fig. 12

Typical starting resistance for a motor with one line run directly to the motor

varies directly as the armature current, since the field strength is nearly constant. In a series motor, however, the field strength varies nearly as the current, as the current is the same through field and armature; hence, the torque varies as the square of the current in the series motor. This type of motor is, therefore, used principally where a heavy starting torque is required.

While the motor is running mechanical work is being done in addition to the energy dissipated as heat in the armature due to its resistance. But the total energy spent in the motor is equal to the product of the current strength and the potential difference of the brushes. Hence, if the current is kept constant, the difference of potential between brushes must be greater

when the armature is running and doing work than when it is at rest. This increase in potential difference at brushes due to the armature rotation is the back E. M. F. of the motor. This is due to the fact that the motor, while running, acts like a generator and develops an E. M F., which acts in opposition to the E. M. F. of the source of supply to the motor.

The resistance of a motor armature is small, and a motor at rest has no back E. M. F. to limit the current at starting. If, therefore, the current were applied without temporary starting resistance in circuit, there would be a heavy rush of current, which might damage the motor. So, the use of a starting-box—rheostat with graduated resistance units, is desirable.

Referring to Fig. 12, one line lead is connected directly to the motor while the other is joined to the terminal of the starting box, as shown. The other terminal of the starter is connected with the motor. When the switch is turned to the second button of the starter, the current flows through the resistance units and starts the armature. As the speed increases and more back E. M. F. is developed, the switch is moved to the next points, reducing the resistance with each step, until, as the armature comes up to full speed, the switch makes direct connection, and the back E. M. F. keeps the current moderate even though the armature resistance may be quite low.

(*To be continued*)

An Easy Method of Renewing Used Carbon Paper

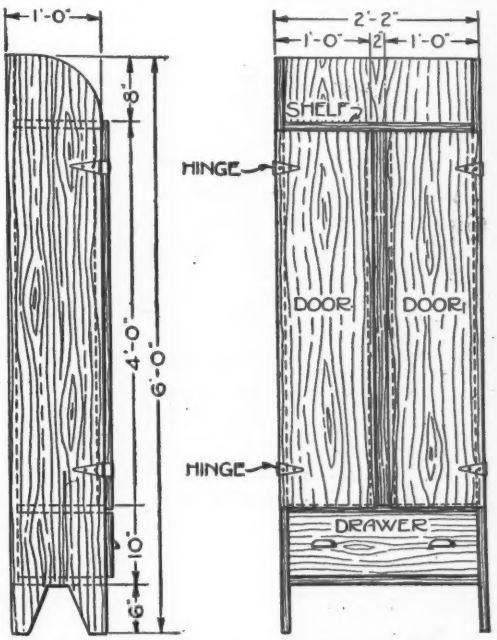
YOUR used carbon or transfer paper can be made to last much longer by simply holding it over an open flame such as a lamp, candle or match, with the carbon side down. The wax substance of the unused parts will melt and run into the thinner sections of the parts which are worn out.—E. M. THAYER.

An Efficient Primer for Starting Gasoline Engines

SPEAKING of anesthetics in connection with automobile troubles, it will be found valuable to remember that a mixture of half ether and half gasoline used as a primer, will often start an obstinate engine when all other means fail.—PETER J. M. CLUTE.

How to Make a Simple Wardrobe for the Camp

THE illustration shows the construction of a very simple wardrobe for a soldier's camp. It can be quickly made



A wardrobe for the camp which may be constructed of packing box material or scrap lumber

from any cheap lumber. Material taken from shipping boxes does very well.

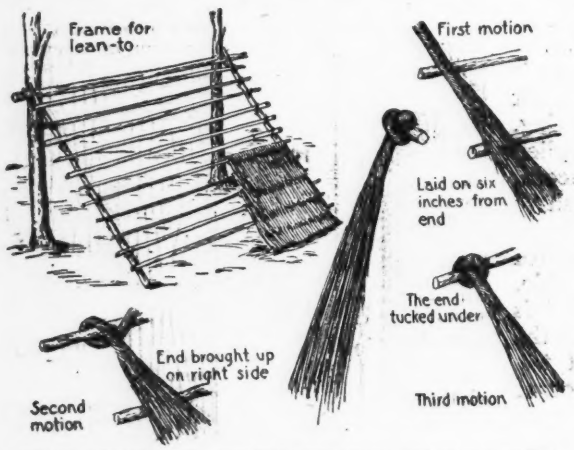
The ends are made up of two boards 6 ft. long and 1 ft. wide, or can be constructed of two narrow boards. The boards forming the back are 5½ ft. long and are nailed to the cross shelves or partitions holding the ends together. A drawer is fitted in the bottom and an 8-in. space is left at the top for a shelf. The wardrobe part is provided with two doors.—GEORGE M. PETERSEN.

Using an Egg Beater to Mix Dry Color in Paint

MIXING dry colors in ready mixed paint with the ordinary paddle to get the desired shade is a decidedly tedious job and unless thoroughly mixed will be streaked and spotted when applied with a brush. A much quicker method of accomplishing the mixing is to use an egg beater, which also eliminates the skin and other foreign matter from the liquid.

How to Make a Thatched Lean-To in an Emergency

WHEN the boys found themselves far from the camp and miles from any habitation, with great storm clouds forming in the west, they knew it meant an all-night stay in the open. As they had neither water-proof coats nor blankets and no hillsides were available, shelter had to be improvised, and improvised quickly.



Poles cut to place against two trees and the method of making the thatching material for covering the poles

They solved the problem in the following manner: Selecting a spot where they found two conveniently-located trees standing about 6 ft. apart, they cut a young sapling 8 ft. long, and two smaller ones each 7 ft. long, these latter ones having a fork at one end. The long sapling was held against the trees horizontally, at an elevation of 5 ft., and the two forked poles were planted in the ground 5 ft. from the trees. They were then leaned over to the trees so that the horizontal sapling rested on the forks. In this way the frame work for a lean-to was provided.

A dozen small saplings, or poles, each 7 ft. long, were then cut and laid on the forked saplings 6 in. apart. As there was no cord convenient they used withes of grass to bind together the intersecting points. At the time the forked poles were cut care was taken not to cut off the branches too close up to the body of the sapling, so that each sapling had a number of spines sticking out. Some of these spines came in handy when the small poles were being applied, as they were laid in the crotches, and thus helped with the withes, to hold the poles in place.

The lean-to thus made had its open side facing the east, as they knew the storm was coming from the west. In case the wind should change its direction during the night, withes were used to bind the forked poles to the trees, and thus make certain that the structure would not be blown away.

Now came the problem of covering the roof frame thus formed. With their knives the boys cut the longest supple grass they could find, a species of wild timothy, the stalks of which were about 18 in. in length. They worked in pairs, one picking up handfuls large enough to form wisps about 1 in. thick, when tightly compressed and twisting them at the top sufficiently tight to form a compact mass, leaving the lower part straight. In this form they were handed to his companion who applied the twisted part to a pole at a point about 6 in. from the upper twisted end, the untwisted part of the wisp being directed downwards along the roof. The real art was in applying the wisp so as to accomplish two things—first, to attach it firmly to the pole, and second, to be sure that it would shed water.

It will be noticed that the wisp is twisted to the right. In that case the short end of the twist, after being bent under the pole, must be brought up on the right side of the body of the wisp, and then crossed over to the left and tucked under the body of the twist

This being done, the wisp is pushed over so that it rests tightly against the adjoining wisp, and the lower untwisted ends are spread out and intertwined, not twisted with the adjacent wisps. In this way the whole becomes matted together, providing a mass which is impervious to water, and able to withstand any air pressure from the under side.

A gable roof may be made by making another lean-to on the other side of the tree. Thus, a permanent house can be constructed which will outlast the season.

Wireless Work in Wartime

XIII.—Further details of the radio receiver

By John V. L. Hogan

IN last month's article the general action of the complete contact-rectifier receiver of Fig. 47 was described; this illustration is again reproduced for reference here. In the diagram, the aerial wires are represented by A, the primary or antenna circuit inductances by L_3 (the load coil) and L_1 (the primary coil), the secondary coil by L_2, the secondary condenser by C_1, the contact rectifier by D, and the telephone and telephone condenser by T and C_2. The curves of Fig. 48 should aid in making clear the operation of the various elements, since the characteristic voltages and currents for each important part of the circuit are shown.

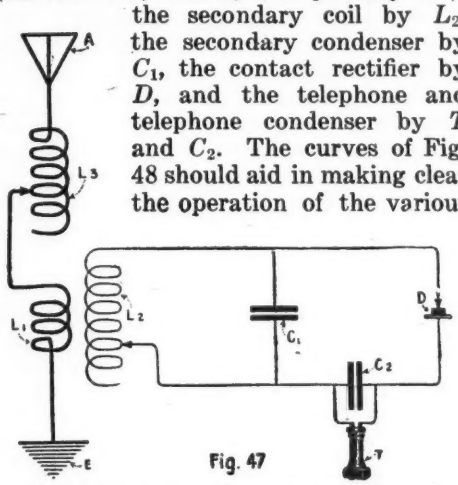


Fig. 47

A complete hookup for a wireless telegraph receiver with aerial circuit in two parts

What Happens in the Receiver

On the upper line of Fig. 48 are plotted three groups of radio frequency voltages such as are set up in the antenna and secondary circuit by any three successive groups of waves which strike the antenna wires. As previously explained, the radio waves passing by the receiving station create alternating voltage impulses in the aerial-to-ground circuit, these pulses setting up corresponding currents through the primary coil. The antenna circuit currents have the same frequency as the waves which induce them; thus, if a 600-meter wave is being received, the aerial current will flow at 500,000 cycles per second. By adjusting the inductance coils to suit the capacity of the antenna and the frequency of the induced currents, the largest possible current is built up by the process of tuning or resonance. This radio frequency alternating current flowing through the primary coil induces similar currents in the secondary, and impresses upon the secondary condenser, C_1, a series of groups of radio frequency potentials such as shown on the first line of Fig. 48.

As would be expected from a study of the wiring diagram, the potential of the condenser, C_1 will attempt to force a discharge current through the detector and telephone circuit at the right. This is where the peculiar feature of the detector, namely, that it passes current more easily in one direction than in the other, is of importance. If we assume the detector to be ideal in that it permits free passage of current in one direction and prohibits its passage in the other, we will find that the current through it corresponds to that shown on the second horizontal line of Fig. 48. Here it is seen that the positive (upward) voltage pulses result in positive currents of brief duration, but that the negative pulses do not force any current through. Thus a series of pulses in one direction is applied across the terminals of the telephone and the telephone condenser. Since the fine wire coil around

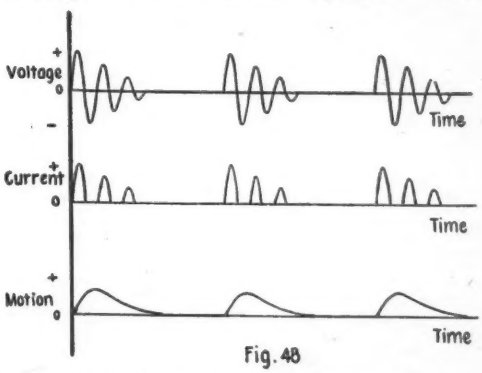


Fig. 48

In this is shown a series of groups of radio frequency potentials set up in the antenna

the telephone magnet pole pieces has high inductance, and since the telephone condenser usually has a fairly large capacity, the group of pulses is smoothed out to some extent, and the movement of the telephone diaphragm is as indicated on the third line of the figure. We thus see that for each group of waves there is produced a single motion of the telephone diaphragm.

Effects of Spark Frequency

Let us consider the effect of spark frequency and regularity upon the sound of the radio signal produced in the receiving telephone. If the sparks in any signal group, dot or dash, occur at equal intervals the telephone diaphragm will be moved regularly, and consequently the sound produced will be musical

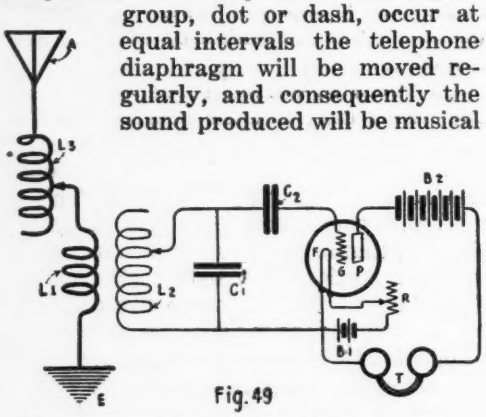


Fig. 49

The vacuum tube or audion detector has come into wide use since the beginning of the war

in character. The pitch of the tone will depend upon the spark frequency; if a spark transmitter having 120 cycle power supply is used, with one spark per half-cycle, 240 sparks per second will be produced and the signal tone will sound slightly lower than middle *C* on the musical scale (which is 256 vibrations per second). If a 500-cycle transmitter is used under the same conditions the sparks will occur at the rate of 1,000 per second, and the signal tone will have a pitch about two octaves higher. On the other hand, regardless of the number of sparks per second, if the sparks occur at irregular intervals in point of time the sounds will not be musical; it is well known as an elementary physical principle that noises are distinguished from musical tones by the lack of regularity in their component impulses, and the action of spark transmitters gives a splendid practical demonstration of this fundamental physical truth.

The skilful radio operator, then, will invariably do everything in his power to keep his transmitter spark regular in occurrence so as to produce at the receiver the clear musical tones which can be distinguished from the harsh noises of atmospheric disturbances. He will also prefer to use high spark frequencies, in the neighborhood of 1,000 per second, so that the musical tone will be not only clear but high pitched and thus still more easily copied in the presence of static and strays.

The Audion Detector

The crystal or contact rectifier is in extensive practical use as a radio detector, and its action must be understood by the war-time operator in either the land or sea service. Another important type of detector which has come into wide use, especially since the beginning of the war, is the vacuum tube or audion. This, in its most practical form, is indicated in Fig. 49. A small incandescent lamp, highly evacuated, contains, in addition to the usual filament, *F*, a wire grid, *G*, and a flat plate, *P*. Sometimes there are two grids and two plates connected together. The filament is lighted by means of a low voltage battery, B_1, and the brilliancy of incandescence is usually controlled by means of a resistance, *R*, in the filament circuit. The grid is connected to the secondary condenser by way of the condenser, C_2, of considerably smaller capacity than when the crystal detector is used; the other terminal of the secondary condenser, C_1, is connected to the filament. A third circuit from the filament to the plate contains another (and higher voltage) battery, B_2, in series with the telephone receiver, *T*.

This vacuum tube detector is considerably more sensitive than the best crystals, and consequently is especially valuable when long distances are to be covered or when feeble transmitters are to be used. The action is in many ways similar to the crystal rectifier, however, since the radio frequency alternating potentials applied to the grid are rectified perfectly so each current-group charges the grid to a higher-than-normal negative potential for a brief time. The effect of this increased negative charge is to reduce the battery current from B_2 flowing through the telephones, and consequently a movement

of the telephone diaphragm is produced for each group of waves received. The particularly useful feature of the audion is that the change in the telephone current thus produced is considerably larger than the current which could be set up by the energy of the received waves alone; thus the audion actually amplifies or increases the signal which is received, and so its marvellous sensitiveness is accounted for.

It is not possible in the limited space allotted to a series of elementary articles of this kind to discuss in detail the many additional uses of the various forms of radio apparatus. To-day the spark system of radiotelegraphy is of tremendous importance, but equally or more necessary is the type of transmission which uses wireless waves produced in continuous or "undamped" streams instead of in groups. The student will find, however, that the fundamental principles of operating and manipulation which have been explained may be applied to any sort of radio apparatus; whether the circuits are simple or complex, or whether the waves are produced continuously or in spark-groups, the same general conceptions will prove helpful in analyzing the apparatus and learning its functions. The complete series, which is closed by this article, should give an adequate idea as to the main points with which one must be familiar in order to use radio apparatus successfully.

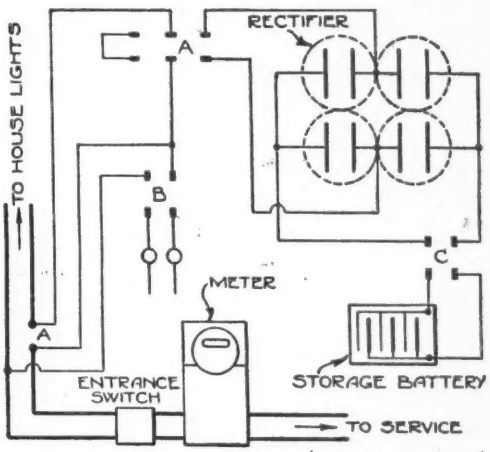
(*The End.*)

An Inexpensive Method of Charging Storage Batteries

THE usual practice in charging storage cells is to use some form of rectifier when the current at hand is A.C. To cut the voltage down a resistance or lamp bank is employed. With current selling at even nine cents a K.W. hour this is rather an expensive proposition, for a large part of the current is wasted in the lamp bank or resistance.

The writer has evolved a simple method of overcoming this defect and always keeping the batteries right up to the mark, the most interesting part being that it costs practically nothing to charge the cells.

The attached illustration will show how this is made possible. After the service wires have passed the entrance switch in the basement, one of them is cut and a lead from each side of the cut is carried to a blade of a D.P.D.T. switch. One set of clips on this switch are short-circuited and the other set are connected with the rectifier, an electrolytic being used in this case. A third wire is also



The connections with rectifier for charging storage cells from an alternating current

connected to take the current direct from the meter.

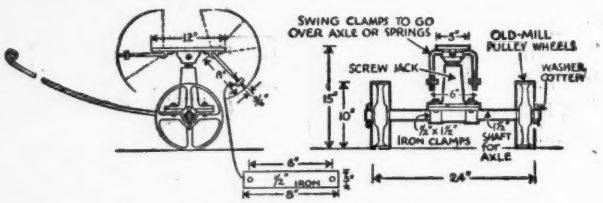
It will be apparent that when the switch *A* is thrown to the right all current used in the house must pass through the rectifier and storage battery; in other words, the house lights act as the lamp bank. There is of course a certain drop in voltage, but this is in nowise detrimental. When the charging is to be stopped for any reason the switch *A* can be thrown to the left, thus cutting out the rectifier.—THOMAS W. BENSON.

Cleaning the Surfaces of Celluloid Articles

CELLULOID articles can rarely be restored to their original whiteness if they have been thoroughly discolored throughout, but if merely superficially discolored, wipe them with a woolen rag wet with absolute alcohol and ether mixed in equal proportions. This dissolves and removes a minute layer of the surface being cleansed and lays bare a new surface. To restore the polish rub briskly with a woolen cloth and finish with silk or chamois. A bit of jeweler's rouge will greatly facilitate matters.

A Homemade Ambulance for Towing in an Automobile

IF an axle or wheel breaks on a pleasure car or truck the whole car may be easily hauled in by means of the ambulance illustrated. It is made from a large screw-jack, a length of 1½-in. shaft for the axle and two pulleys or belt wheels. The base of the jack is clamped to the axle in the center and the pulleys placed on the ends. A draw-bar or tongue is also fastened to the base of the screw-jack.



Dimensions of the parts for making a two-wheeled ambulance to tow in broken down automobiles

If it is the front axle that has been damaged, the ambulance is run under it and the jack raised to lift the automobile axle, after which the axle of the ambulance is supported by a rope run to some part on the rear axle to keep it from pulling out from beneath the car. If the rear axle is damaged, the ambulance is placed under it in the same way and the rope is run to some part of the axle on the front of the car.—P. P. AVERY.

A Way to Determine if Copper Is Used in Canned Goods

COPPER compounds are often used in canned goods, such as peas, beans, and spinach, to give additional depth to the green tint. Precautionary measures should be taken to detect the presence of these compounds. Vegetables suspected of containing copper should be mashed in a dish, a little muriatic acid added and the contents warmed. The residue is strained out through a fine cloth and thrown away. The resultant liquid is kept and ammonia water in excess of the acid is added to it. The presence of a deep blue coloration shows that the substance tested contains copper. This simple test will enable one to avoid copper poisoning.

Cleaning Dirt and Grease Marks from Tracings

TRACINGS may be very readily cleaned and pencil marks removed by the use of benzine, applied with a cotton swab. It may be rubbed freely over the surface without fear of injury to the lines drawn in ink, or even water colors, but pencil marks and dirt will quickly disappear. The benzine evaporates almost immediately, leaving the tracing unharmed. The surface, however, will be somewhat softened, and should be rubbed down with a little powdered talc or chalk, before drawing more ink lines.

Screening Gravel as It Is Loaded Into Dump Wagons

THE handling of gravel and passing it over screens for building highways added considerable cost to each yard of the material handled, but an ingenious screen invented by Donald A. Thomas, and adopted by the Michigan Highway Department, reduced this cost to one-half.

The screen used is 3 ft. wide, and the length of the dump wagon is usually about 9 ft. The frame is made of 2 by 4-in. stock with two cross-braces of the same material. It is covered with screen wire having ¼-in to ⅓-in. mesh, which gives a satisfactory product. The angle at which the screen is set can be varied to suit the material being dug. The lower edge of the screen is provided with hooks to hang on the side boards of the wagon, while the other side of the screen is supported by posts hinged on bolts to the edge of the frame.

A screen fastened to a wagon box onto which the gravel is thrown for screening out the smaller pebbles

A New American Ball Game Using the Inflated Ball

THIS new game is called American Ball because it is adapted from and includes the best elements of the three great American games that are played with a large inflated ball,—college foot-ball, soccer foot-ball and basket-ball. Its rules are simple, its play varied, and its action vigorous.

The equipment consists of a ball—a soccer foot-ball is used—and an outdoor field, 100 by 200 ft.

The goals are a combination of those used in the three games: Uprights are erected 15 ft. apart at each end of the field. Two cross pieces are nailed horizontally to these uprights, one 8 ft. and the other 10 ft. from the ground, with an 18-in. space between them.

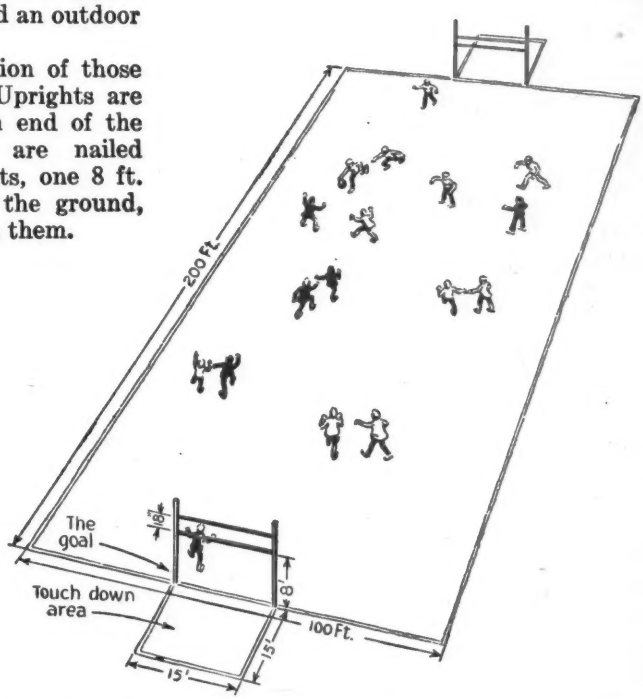
The touch-down area is a 15-ft. square marked on the ground just back of the goal posts. The teams consist of eight players — one goal keeper, two guards and five forwards.

The game shall consist of forty minutes' actual playing time, divided into ten minute quarters, with three minutes rest between quarters. One of the distinctive features of the game is that the ball may be advanced or played in any direction in almost any manner—by carrying, kicking, throwing, striking, or dribbling.

The side that wins the toss-up has the choice of goals or of putting the ball into play. At the beginning of each quarter, and after a goal is made, the ball is put in play at the center of the field in any of the following ways: (1) As in a foot-ball scrimmage, (2) by a soccer kick-off, (3) by a toss-up as in basket-ball, (4) by any kind of a throw or kick in any direction, (5) by running with the ball after the referee has blown the whistle to start the game.

The captain informs the referee which method of putting the ball into play he desires. The referee then announces it to the teams and gives them time to put their players in position. He then blows his whistle, after which the ball must be put into play within ten seconds, or be given to the other team to put into play.

The players must be "on sides" only if the foot-ball or the soccer style of play is chosen for the start. If a free place-kick is chosen, the opponents must not be nearer than five yards until the play begins. If a free throw or a run is chosen, the opponents may approach within 8 ft.



A ball game that is adapted from and includes the best elements of the three great American games played with the large inflated ball—college foot-ball, soccer foot-ball, and basket-ball

of the player with the ball. After a goal is made, the losers put the ball in play at the center. At the quarters, the teams alternate. A "down" is made when a player who has the ball (holds it in any manner) is touched by an opponent. The ball is then "dead" and goes to the opponents to be put in play on that spot. On a "down" the ball may be put in play by a free throw or kick in any direction within ten seconds after the referee blows his whistle, during which time the opponents may approach not nearer than 8 ft. to the player. The ball must not be put in play until the referee's whistle blows,

which must not be until the opponents have had time to place their men to guard the play.

When the ball is out of bounds. When the ball goes or is carried across the side boundary lines it is given to the opponents to put in play at the spot where it crossed the line. This may be done by any kind of throw or kick in any direction into the field.

When the ball goes out of bounds across the end boundary lines at or near the goals, it shall be put in play at a point 25 ft. from the nearest goal post.

A "touch-down" is made when a player runs with the ball and without being touched, himself, touches the ball to the ground in the touch-down area. The ball may be carried out of bounds only on a manifest attempt to make a touch-down.

A goal is made by kicking the ball either over, under or between the goal cross pieces from the field, which scores two points. The side making a touch-down scores three points. Throwing the ball through the 18-in. opening means a gain of only two points.

A foul by an opponent or a touch-down by a player entitles a team to a free try for goal. The team may select either a free throw for the 18-in. space from a 20 ft. mark, or a free kick from the yard mark as in soccer or foot-ball. A goal from a free throw or kick scores one point. During a try from a free throw or kick all players except the guarding goal keeper must be back of the ball until the throw or kick is made.

A foul is made by excessive roughness, such as downing, tackling, tripping, striking, holding. The referee must decide. If fouls are extreme, the referee shall disqualify the offender.

It will be noted that American ball allows a great deal of latitude and for that reason is a joy to both player and spectator. Most big games have too many restrictions.

American ball calls for quick judgment and action, and because there is little danger of accident, it does away with the objections found to so many of the other big games.

Since this game can be played equally well on skates, it makes a good winter sport and thus can be played in one form or other all the year round. When played on ice, it is well to waterproof the leather cover of the ball used. This game is very popular where it is now played.

A Porch-Swing Support Made of Pipe and Fittings

THE illustration shows the construction of a porch-swing support built by a gasfitter from materials he was proficient in handling; however, this material makes it quite convenient for any person not so well informed on mechanics to put together after the parts are made ready by a local plumber.

Pipe and fittings joined in such a way that it makes a substantial swing support

Pipe ¾ or 1 in. in size is suitable. Dimensions can be adjusted to suit conditions. The whole affair can be dismantled by unscrewing the two unions in the lower braces. As the swing is hung near the uprights it will easily hold the weight of the occupants.—JAMES M. KANE.

Repairing a Speedometer Shaft With a Nail

FOR repairing the shafts of speedometers of the link type, I have found that a very satisfactory job can be made by taking a finishing nail of the proper length and size to suit the size of the speedometer shaft it is desired to repair, and by cutting off the point and head and bending to the proper link shape. This work can be quickly and conveniently done with a pair of wire cutters and a steel punch.—H. K. CAPPS.